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REPORT

OF THE

COLLEGE OF AGRICULTURE

AND THE

AGRICULTURAL EXPERIMENT STATION

OF THE

UNIVERSITY OF CALIFORNIA

FROM JULY 1, 1913, TO JUNE 30, 1914

Y31
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1914

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UNIVERSITY OF CALIFORNIA PUBLICATIONS

REPORT

OF THE

COLLEGE OF AGRICULTURE

AND THE

AGRICULTURAL EXPERIMENT STATION

OF THE

UNIVERSITY OF CALIFORNIA

FROM JULY 1, 1913, TO JUNE 30, 1914

UNIVERSITY OF CALIFORNIA PRESS
BERKELEY
1914

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REPORT OF THE DIRECTOR

To the President of the University of California;

Sir:—In submitting to you the work of the Department of Agriculture of the University of California for the year ending June 30, 1914, it seems desirable to emphasize the motives and purposes which have guided the members of the staff. The founders of the Smithsonian Institution, established at Washington, D. C., in 1846, declared their purpose to be the creation and diffusion of knowledge. It was not to be judicial, legislative, nor executive. Thus a new function of national import was created. In like manner it is the purpose of the Department of Agriculture of the University of California to discover and instruct, but not to control nor direct. The Department seeks to find the truth as it relates to agricultural methods and processes and by various means of education to instruct as many persons as possible in the results of research obtained by this and other agricultural experiment stations. Its means of education may be divided into two groups: internal and external.

INTERNAL INSTRUCTION

The internal instruction of the Department of Agriculture may be divided into four types: (1) Post-graduate instruction leading to a master's or doctor's degree, which may be taken at Berkeley, Davis, Riverside, Whittier, or El Centro. (2) Undergraduate instruction leading to a bachelor's degree and requiring four years, which may be taken at Berkeley or in part at Berkeley and in part at Davis. Students may major in seventeen groups of subjects. (3) University Farm School instruction at Davis, for which a certificate is given at the completion of three years' work. (4) Short course instruction of six weeks at Davis, occurring usually in October and November, and open to all persons over eighteen years of age, without academic requirements. During the year, 1913–14, the attendance upon these several types of instruction has been as follows:

(1) Post-graduate	24
(2) Undergraduate	552
(3) University Farm School	210
(4) Short courses	134

The following table shows the instruction given to undergraduate students by the several divisions of the Department of Agriculture:

	First Semester			Second Semester		
Subject	Completed	Withdrew	Total	Completed	Withdrew	Total
Agricultural Chemistry	100	9	109	25	1	26
Agricultural Education	25	....	25	43	1	44
Agriculture	108	18	126	13	1	14
Agronomy	179	22	201	125	7	132
Animal Husbandry	23	1	24	115	6	121
Citriculture	59	2	61	58	5	63
Dairy Industry	11	3	14	28	2	30
Entomology	166	25	191	399	68	467
Parasitology	117	8	125	17	....	17
Landscape Gard. and Floricul.	28	3	31	113	5	118
Genetics	16	....	16	38	1	39
Horticulture	5	....	5	234	46	280
Nutrition	301	53	354	235	32	267
Plant Pathology	54	3	57	63	4	67
Pomology	88	5	93	69	3	72
Soils	94	12	106	124	8	132
Veterinary Science	9	2	11	35	4	39
Viticulture and Enology	31	6	37	55	6	61
Farm Mechanics	.....	....	.....	46	1	47
Forestry	.....	....	.....	48	3	51
Poultry Husbandry	.....	....	.....	11	1	12
Scientific Illustration	.....	....	.....	10	....	10
Irrigation Practice	.....	....	.....	22	....	22
			1586			2131

There has been a marked betterment in the standard of instruction in the Department of Agriculture during the year. This has been due to a decided increase in the subject matter offered, to more extended laboratory facilities, and to an insistence that the student shall make adequate preparation for his daily tasks. The courses of study have been amplified and standardized and brought into harmony with the best traditions of university life. The announcement of graduate courses of study in agriculture is much more complete than has heretofore been attempted. The contribution to the summer session by the several divisions of the Department has been most hearty and gratifying in view of the fact that no additional stipend is given for this work. Fourteen summer practice courses have been organized to meet the needs of students, who have completed the sophomore year, for practical experience along the line of their major work. University instruction at the University Farm has been devel-

oped both along scientific and practical lines. The work continues to grow in popularity to such an extent that the 61 University students who were in residence there this semester have petitioned unanimously that University instruction be provided throughout the year in place of merely in the second half-year as at present. For financial and other reasons, it was necessary to deny this petition, but probably the time will soon come when it will be necessary to provide such work throughout the year, not only for the purpose of increasing its efficiency but also to relieve the pressure at Berkeley. For discussion of instruction at the University Farm School see page 52.

EXTERNAL INSTRUCTION

The forms of external instruction are extremely varied. They consist of the distribution of reports, bulletins, and circulars of the Agricultural Experiment Station, of which about 425,000 copies have been distributed during the year; of correspondence instruction, numbering 8833 individuals; and a voluminous correspondence in answer to inquiries. There have been written by members of the staff during the year ending June 30, 1914, 67,417 letters, not including the acknowledgment of requests for bulletins or corrections of correspondence lessons. Soil samples to the number of 2200 have been examined relative to alkali or plant food content and report rendered as to adaptability for crops or methods of tillage and fertilization.

Farmers' Institutes, movable schools, agricultural clubs, exhibits at fairs, personal visits to farms, are all used by the Extension Division in carrying the discoveries of the Station to the people. The Extension Division estimates that it has reached, through these agencies, not excluding duplicates, 175,000 persons during the present year.

A system of farm advisers or county agents has been started, creating the most direct method of bringing the man or woman on the land in personal touch with the work of the Station. Farm advisers have been established in Humboldt, San Diego, Yolo, and San Joaquin Counties, while the following counties have made the necessary appropriations and are awaiting the appointment of a farm adviser: Madera, Ventura, Napa, Alameda, Kern, and Solano. These additional advisers have been made possible, by the United States Congress, by the passage of the Smith-Lever Act, copy of which will be found in the appendix of this report. Since the creation

of the system of farm advisers illustrates the function of the Department to discover and instruct or advise, the organization of the farm adviser system will be described briefly.

No farm adviser in California is placed in any county until the people of that county, through their own initiative, ask for it. The University offers to appoint and pay the salary of a farm adviser only after the Board of Supervisors has appropriated $2000 for the annual expenses of the adviser and there has been organized a farm bureau of at least one-fifth the farmers of the county with an annual membership of one dollar. The farm adviser is required to serve any farmer of the county, whether a member of the bureau or not, but he is instructed not to visit any farm unless he is invited to do so. The purpose of the farm bureau is first to demonstrate whether the farm adviser is really wanted by the farmers themselves, and second to create an efficient working agency, as explained in Circular No. 118 of this Station. The farm adviser does not seek to control or direct the action of any person. He gives to each person the best advice of which he is capable through the aid of the staff of the Agricultural Experiment Station, but the initiative still rests with the person seeking the advice. If, for the successful prosecution of the methods advised, it is necessary to have concerted action, or if it is necessary to pass and execute laws, the people themselves must take the next necessary steps; or the legislative and executive branches of the Government must create and execute such measures as the investigations of the Station show to be warranted by the facts.

In the same manner the State Board of Control arranged with the President of the University to have this Department examine into the farming operations of the various state institutions. During the month of April, 1914, the Director of the Station, with two other members of the staff, visited, examined into, and has prepared reports about the agricultural aspects of the following institutions and properties:

Mendocino State Hospital; located at Talmage, 3 miles from Ukiah.
Sonoma State Home; located at Eldridge, Sonoma County.
Napa State Hospital, Napa County.
Veterans' Home, Yountville.
Frye Ranch, near Yountville, Napa County.
San Quentin Prison, San Quentin.
Preston School of Industry, Waterman, near Ione.
Folsom Prison, Represa.
Stockton State Hospital, Stockton.
Agnews State Hospital, Agnews.
California School for Girls, Ventura.

Whittier State School, Whittier.
New State Hospital Site, Norwalk, 5 miles from Whittier.
Southern California State Hospital, Patton, San Bernardino County.

The purpose of these visits was to so acquaint members of the staff with the physical and business aspects of the agricultural operations that they will be able to give the officers of the several institutions such advice as they may, from time to time, desire. It is perhaps needless to remark that the Department of Agriculture of the University does not accept any responsibility for the conduct of the agricultural affairs of the several institutions. This Department stands in just the same relation to them as it does to every person in California who is seeking to create wealth from the soil. Each has the privilege of seeking and receiving, without charge, any information or advice which the Station is capable of giving.

Since technical advice is given alike to all persons desirous of creating wealth from the soil, there is no significance to be attached to the fact that some member of the staff has advised a particular person or firm concerning his or its operations. In giving information regarding the growing of crops or the rearing of animals, members of the staff do not assume any responsibility or necessarily vouch for the commercial aspect of any enterprise. The department will not assist in the exploitation or sale of property.

Ministers' week, held at the University Farm, Davis, December 1–5, 1913, was attended by 489 clergymen actually in charge of churches, six theological students, four missionaries, and two laymen.

Ministers' Week is another illustration of a method of diffusing knowledge relating to agriculture. Through the suggestion to the President of the University by the Rev. F. I. Drexler, a Baptist Minister at Willows, California, a course of seventy-five lectures and demonstrations was given at the University Farm at Davis, December 1 to 5, 1913, which was attended by 489 clergymen actually in charge of churches. There were in addition six theological students, four missionaries and two laymen, making a total attendance of 501. Forty-nine counties and eighteen denominations were represented. There are said to be 2600 clergymen in California. Presumably half or more of them have their pastorates in the larger cities.

The purpose of this course of lectures was not intended to make clergymen into farmers. Its purpose was to acquaint clergymen with the agricultural problems and practices of their times so they may be intelligently informed on the business of their people. This is by no means the first time that rural ministers have come together for a conference. It is believed, however, that the point of view of this programme is sufficiently unique to justify its publication:

MONDAY, DECEMBER 1

7:30–10:00 P.M.

"Get-together Meeting."

"Address of Welcome."

By Dean H. E. Van Norman.

"Response."

By Rev. F. I. Drexler, Pastor Baptist Church, Willows, Calif. Followed by informal reception of visitors by faculty and students of the Farm School.

TUESDAY, DECEMBER 2

8:00–9:00 A.M.

"Judging Beef Cattle."

Demonstration by Mr. V. R. Dolcini.

9:00–10:00 A.M.

"Grapes in California."

Lecture by Professor F. T. Bioletti.

"Selecting a Poultry Farm."

Lecture by Professor J. E. Dougherty.

"The Formation of Soils."

Lecture by Professor C. F. Shaw.

"Irrigation Resources of California."

Lecture by Mr. Frank Adams, U. S. Department of Agriculture.

10:30–11:30 A.M.

"Building a Poultry House."

Lecture by Professor J. E. Dougherty.

"The Soil Survey of California."
Lecture by Professor C. F. Shaw.
"Fundamental Principles of Plant Breeding."
Lecture by Professor E. B. Babcock.
"Economic Importance of Plant Diseases."
Lecture by Professor W. T. Horne. Illustrated by lantern slides.

1:00–2:00 P.M.
"Irrigation Investigations."
Lecture by Mr. S. H. Beckett. Illustrated by lantern slides.
"The Feeding of the Laying Hen."
Lecture by Professor J. E. Dougherty.
"Citriculture."
Lecture by Professor J. E. Coit. Illustrated by lantern slides.
"The Ministers' Interest in Plant Breeding."
Lecture by Professor E. B. Babcock. Illustrated by lantern slides.

2:30–5:30 P.M.
Inspection of rural schools to observe improvements made.
Field Trip—Professors W. G. Hummel and O. J. Kern.

3:30–4:30 P.M.
"Budding, Grafting and Making Cuttings."
Demonstration by Mr. R. H. Taylor.

4:00–5:00 P.M.
"Pruning Methods with Grapes."
Demonstration by Professor F. T. Bioletti.

7:30–10:00 P.M.
"What the Country Life Movement Means."
Address by Dean Thomas Forsyth Hunt.
"What the County Work Strives to Do."
Address by Mr. Wm. D. McRae, State County Work Secretary, Y. M. C. A.
"What this Movement Means to the Metropolis."
Address by Mr. Robert Newton Lynch, California Development Board.

WEDNESDAY, DECEMBER 3

8:00–9:00 A.M.
"Pickling Methods with Olives."
Demonstration by Mr. W. F. Oglesby.
"Judging Mutton Sheep."
Demonstration by Mr. C. R. George.

9:00–10:00 A.M.
"Fruit Handling and Storage."
Lecture by Professor B. B. Pratt.
"Incubation and Brooding of Poultry."
Lecture by Professor J. E. Dougherty.
"Rural Hygiene and Sanitation."
Lecture by Professor W. B. Herms. Illustrated by lantern slides.

10:30–11:30 A.M.
"Selection of Orchard Locations."
Lecture by Professor B. B. Pratt.

"What are the Factors of Successful Farming?"
Lecture by Professor J. W. Gilmore.
"Conservation of Health on the Farm."
Lecture by Professor W. B. Herms. Illustrated by lantern slides.
"How the Food and Drug Regulation Effects the Consumer."
Lecture by Professor M. E. Jaffa. Illustrated by lantern slides.

1:00–2:00 P.M.
Round Table Discussion—"Social Activities of the Rural Church."
Professor B. H. Crocheron, Chairman.

2:00–3:00 P.M.
"Food as Preventive Medicine."
Lecture by Professor M. E. Jaffa.
"Olives in California."
Lecture by Mr. W. F. Oglesby.
"Agriculture in Relation to National Welfare."
Lecture by Professor J. W. Gilmore.
"Community Work in Rural Schools."
Lecture by Professor W. G. Hummel. Illustrated by lantern slides.

3:30–4:30 P.M.
"Pruning a Young Orchard."
Demonstration by Professor B. B. Pratt.
"Administration of Anti-hog Cholera Serum."
Demonstration by Dr. F. M. Hayes.

4:30–6:00 P.M.
"Mixing Lime-Sulphur."
Demonstration by Mr. Leslie J. Nickels.

7:30–10:00 P.M.
"Country Communities and Social Life."
Address by Acting President D. P. Barrows.
"Relation of Educational Work to the Farm."
Address by Judge Peter J. Shields.
"Results from the Rural Church Surveys."
Address by Dr. Warren H. Wilson, Superintendent, Department Church and Country Life Board of Home Missions, Presbyterian Church.

10:00 P.M.
Injection of Cow in Application of Tuberculin Test.

THURSDAY, DECEMBER 4

8:00–9:00 A.M.
"Judging Hogs."
Demonstration by Mr. V. R. Dolcini.
"Irrigation Methods."
Demonstration by Mr. S. H. Beckett.

9:00–10:00 A.M.
"Socializing of the Country School."
Lecture by Professor O. J. Kern. Illustrated by lantern slides.
"Ornamentation of Home Grounds."
Lecture by Professor J. W. Gregg. Illustrated by lantern slides.
"Selection of the Dairy Cow."
Demonstration lecture by Dean H. E. Van Norman.

10:30–11:30 A.M.

"Agricultural Education in the Country."
Lecture by Professor O. J. Kern. Illustrated by lantern slides.

"School Ground Development."
Lecture by Professor J. W. Gregg. Illustrated by lantern slides.

"Care and Handling of Milk."
Lecture by Professor L. M. Davis.

"Nature and Study of Plant Diseases.
Lecture by Professor R. E. Smith. Illustrated by lantern slides.

12:45 P.M.

"Observation of Tuberculin Test in progress.

1:00–2:00 P.M.

Round Table Discussion—"The Clergyman's Part in Rural Organization."
Professor B. H. Crocheron, Chairman.

2:00–3:00 P.M.

"The Situation with Regard to California Forage Plants and Grasses."
Lecture by Professor E. J. Wickson.

"Plant Materials"—a discussion of the most common plants that may be used for home and school decoration.
Lecture and Inspection Trip by Professor R. T. Stevens.

"Conserving the Soil Moisture."
Lecture by Professor C. F. Shaw.

"Cow-testing Associations."
Lecture by Dean H. E. Van Norman.

3:30–4:30 P.M.

"Operation of Hand Separators."
Demonstration by Professor L. M. Davis.

4:30–6:00 P.M.

"Incubation Methods with Poultry."
Demonstration by Professor J. E. Dougherty.

Finish of Tuberculin Test with slaughter of reacting cow.
Demonstration by Dr. C. M. Haring.

7:30–10:00 P.M.

"How are Young Men to Become Farmers?"
Address by Dean Thomas Forsyth Hunt.

"What Can be Done to Improve the Human Race."
Address by Director H. J. Webber.

"Organization of the Rural Church."
Address by Dr. Warren H. Wilson.

FRIDAY, DECEMBER 5

8:00–9:00 A.M.

"Judging Draft Horses."
Demonstration by Professor G. H. True.

9:00–10:00 A.M.

"Parasites."
Lecture by Professor C. W. Woodworth. Illustrated by lantern slides.

"Chemical Relations of Soil Fertility."
Lecture by Professor C. B. Lipman. Illustrated by lantern slides.
"Control of Plant Diseases."
Lecture by Mr. S. S. Rogers. Illustrated by lantern slides.

10:30–11:30 A.M.
"Spraying."
Lecture by Professor C. W. Woodworth. Illustrated by lantern slides.
"Semi-tropical Pomology."
Lecture by Professor J. E. Coit. Illustrated by lantern slides.
"Irrigation Methods and Practice in California."
Lecture by Professor B. A. Etcheverry. Illustrated by lantern slides.

1:00–2:00 P.M.
Round Table Discussion—"Heredity as a Factor in the Rural Community."
Prof. B. H. Crocheron, Chairman.

2:00–3:00 P.M.
"Bacterial Relations of Soil Fertility."
Lecture by Professor C. B. Lipman.
"Irrigation Institutions in California."
Lecture by Mr. A. E. Chandler.
"Building up a Dairy Herd."
Lecture by Professor G. H. True.
"Fighting Disease on the Farm."
Lecture by Professor W. B. Herms.

3:30–6:00 P.M.
"An Inspection of Soil Conditions near Davis."
Field Trip—Professor C. F. Shaw.

3:30–4:30 P.M.
"Pruning an Old Orchard."
Demonstration by Professor B. B. Pratt.

4:30–5:30 P.M.
"House Fumigation."
Demonstration by Professor C. W. Woodworth.

7:30–10:00 P.M.
"Extension Work in the College of Agriculture."
Address by Professor W. T. Clarke.
"The County Farm Adviser and his Work."
Address by Professor B. H. Crocheron.
"The Social Economics of Agriculture."
Address by Professor C. H. Parker.

No member of the staff of the Department of Agriculture sought to discuss with the clergymen their problems, but aimed to give them an intelligent conception of the agricultural problems of their communities. Such men, however, as Dr. Warren H. Wilson, and others, spoke on the pastor's opportunities and responsibilities and a Round Table was conducted each afternoon, where the ministers discussed

their own problems. The railroads of California furnished transportation to ordained ministers actually in charge of churches,—as is permitted by law, and the University Farm furnished living accommodations. The purpose of this series of lectures was not, of course, primarily to help ministers, but for the purpose of using one of the most effective agencies in the state for carrying to the people a knowledge of the broader problems of agriculture.

Although less unique, the California Fruit Growers' Convention was held at the University Farm, Davis, California, from June 1st to 6th, 1914, under the auspices of the State Commissioner of Horticulture, Dr. A. J. Cook, the Yolo County Board of Trade, and the College of Agriculture, University of California. There were many notable addresses among the 220 given, twelve persons coming from outside the state for the purpose. There were 791 registrations, and it is believed that well beyond a thousand persons were in attendance.

There have been many other meetings and conferences by associations and groups of people, including the Horticultural Assembly at Riverside on November 15, 1913, with an attendance of about 600; a conference of Veterinarians at Berkeley on July 11 and 12, 1913, on the subject of Tuberculosis in Domestic Animals, at which Dr. Veranus A. Moore, Dean of New York State Veterinary College at Cornell University, and Dr. M. P. Ravenel, Professor of Hygiene, University of Wisconsin, were present. During the year the following associations held meetings at the University Farm at Davis:

Swine Breeders' Association	November 7, 1913
Ministers' Week	December 1 to 5, 1913
District Library Meeting	March 14, 1914
Women's Clubs—Northern District	April 2, 1914
Horse Breeders' Association	May 16, 1914
Fruit Growers' Convention	June 1 to 6, 1914
Swine Breeders' Association	June 2, 1914

INVESTIGATIONS

It must be patent to everyone that if the Department of Agriculture assumes, in a state with the varied resources of California, the responsibility of giving advice to all seeking it, it has a somewhat herculean task. The Land Grant Act of 1862 provided, among other things, for the teaching of agriculture in an institution of college grade. At the end of a couple of decades it became apparent that in order to teach agriculture successfully there must be some accurate knowledge of agriculture to teach. This led to the Hatch Act of 1888, establishing the Agricultural Experiment Stations of the country,

and to the Adams Act in 1906 for their further development. In view of the recent action of Congress in passing the Smith-Lever Bill, the several Acts of the Federal Congress, which affect by appropriation the work of the College of Agriculture, are stated below:

1. THE LAND GRANT ACT, OR MORRILL ACT

Public Laws of the United States, 1862, Chapter 130

(Approved by President Lincoln, July 2, 1862)

An Act donating public lands to the several States and Territories which may provide colleges for the benefit of agriculture and the mechanic arts, granting to the several States, for the purposes hereinafter mentioned, an amount of public land, to be apportioned to each State a quantity equal to thirty thousand acres for each Senator and Representative in Congress to which the States are respectively entitled by the apportionment under the Census of 1860: Provided, That no mineral lands shall be selected or purchased under the provisions of this act.

II. CONGRESSIONAL INDUSTRIAL FUND, OR SECOND MORRILL ACT

(Approved by President Harrison, August 30, 1890)

An Act to apply a portion of the proceeds of the public lands to the more complete endowment and support of the colleges for the benefit of agriculture and the mechanic arts established under the provisions of an act of Congress approved July second, eighteen hundred and sixty-two, annually appropriating, out of any money in the Treasury not otherwise appropriated, arising from the sales of public lands, to be paid as hereinafter provided, to each State and Territory for the more complete endowment and maintenance of colleges for the benefit of agriculture and the mechanic arts now established or which may be hereafter established, in accordance with an act of Congress approved July second, eighteen hundred and sixty-two, the sum of fifteen thousand dollars for the year ending June thirtieth, eighteen hundred and ninety, and an annual increase of the amount of such appropriation thereafter for ten years by additional sum of one thousand dollars over the preceding year, and the annual amount to be paid thereafter to each State and Territory shall be twenty-five thousand dollars to be applied only to instruction in agriculture, the mechanic arts, the English language and the various branches of mathematical, physical, natural and economic science, with special reference to their application in the industries of life and to the facilities for such instruction.

III. THE HATCH ACT, OR EXPERIMENT STATION ACT

(Approved by President Cleveland, March 2, 1887)

An Act to establish agricultural experiment stations in connection with the colleges established in the several States under the provisions of an act approved July second, eighteen hundred and sixty-two, and of the acts supplementary thereto, appropriating to each State, to be specially provided for by Congress in the appropriation from year to year, and to each Territory entitled under the provisions of section eight of this act, out of any money in the treasury proceeding from tne sales of public lands, to be paid in equal quarterly payments, on the first day of January, April, July and October in each year.

IV. Adams Act, or Second Experiment Station Act

(Approved by President Roosevelt, March 16, 1906)

An Act to provide for an increased annual appropriation for agricultural experiment stations and regulating the expenditure thereof, annually appropriating out of any money in the Treasury not otherwise appropriated, to be paid as hereinafter provided, to each State and Territory, for the more complete endowment and maintenance of agricultural experiment stations now established or which may hereafter be established in accordance with the Act of Congress approved March second, eighteen hundred and eighty-seven, the sum of five thousand dollars in addition to the sum named in said Act for the year ending June thirtieth, nineteen hundred and six, and an annual increase of the amount of such appropriation thereafter for five years by an additional sum of two thousand dollars over the preceding year, and the annual amount to be paid thereafter to each State and Territory shall be thirty thousand dollars, to be applied only to paying the necessary expenses of conducting original researches or experiments bearing directly on the agricultural industry of the United States, having due regard to the varying conditions and needs of the respective States or Territories.

V. Nelson Amendment, or Third Endowment Act

The following clause was inserted in the Act making appropriations for the United States Department of Agriculture, for the year ending June 30, 1908. (Act approved March 14, 1907):

. . . That there shall be, and hereby is, annually appropriated, out of any money in the Treasury not otherwise appropriated, to be paid as hereinafter provided to each State and Territory for the more complete endowment and maintenance of agricultural colleges now established, or which may hereafter be established, in accordance with the act of Congress approved July second, eighteen hundred and sixty-two, and the Act of Congress approved August thirtieth, eighteen hundred and ninety, the sum of five thousand dollars, in addition to the sums named in the said act, for the fiscal year ending June thirtieth, nineteen hundred and eight, and an annual increase of the amount of such appropriation thereafter for four years by an additional sum of five thousand dollars over the preceding year, and the annual sum to be paid thereafter to each State and Territory shall be fifty thousand dollars, to be applied only for the purposes of the agricultural colleges as defined and limited in the Act of Congress approved July second, eighteen hundred and sixty-two, and the Act of Congress approved August thirtieth, eighteen hundred and ninety.

Smith-Lever Act

(Approved by President Wilson, May 8, 1914)

An Act to provide for co-operative agricultural extension work between the agricultural colleges in the several States receiving the benefits of an Act of Congress approved July second, eighteen hundred and sixty-two, and permanently appropriating out of any money in the Treasury not otherwise appropriated, the sum of $480,000 for each year, $10,000 of which shall be paid annually, in the manner hereinafter provided, to each State which shall by action of its legislature assent to the provisions of this Act: Provided, That

payment of such installments of the appropriation hereinbefore made as shall become due to any State before the adjournment of the regular session of the legislature meeting next after the passage of this Act may, in the absence of prior legislative assent, be made upon the assent of the governor thereof, duly certified to the Secretary of the Treasury: Provided further, That there is also appropriated an additional sum of $600,000 for the fiscal year following that in which the foregoing appropriation first becomes available, and for each year thereafter for seven years a sum exceeding by $500,000 the sum appropriated for each preceding year, and for each year thereafter there is permanently appropriated for each year the sum of $4,100,000 in addition to the sum of $480,000 hereinbefore provided: Provided further, That before the funds herein appropriated shall become available to any college for any fiscal year plans for the work to be carried on under this Act shall be submitted by the proper officials of each college and approved by the Secretary of Agriculture. Such additional sums shall be used only for the purpose hereinbefore stated, and shall be allotted annually to each State by the Secretary of Agriculture and paid in the manner hereinbefore provided, in the proportion which the rural population of each State bears to the total rural population of all the States as determined by the next preceding Federal census: Provided further, That no payment out of the additional appropriations herein provided shall be made in any year to any State until an equal sum has been appropriated for that year by the legislature of such State, or provided by State, county, college, local authority, or individual contributions from within the State, for the maintenance of the co-operative agricultural extension work provided for in this Act.

RESEARCH FUNDAMENTAL TO SUCCESS

It must be obvious to a thoughtful person that the research work of the Department of Agriculture of the University of California is fundamental to its success. Without accurate knowledge it is impossible to instruct or to advise properly. There is no warrant for an Extension Division or a Farm Adviser unless the Experiment Station, through painstaking investigations, has created knowledge that is worthy of credence. There are only two satisfactory reasons for the nation and the state's maintaining an Experiment Station: one is that it shall extend the realm of knowledge concerning agriculture; the other is that those who investigate shall have no motive to do other than discover and state the truth. The highest quality an investigator can have is the ability to be judicial. The value of the man of research to the public does not lie so much in the special technical knowledge which he possesses as in the fact that his own welfare is in no way affected by the conclusions which he reaches. During the year 198 projects have been outlined. Data have been collected and placed on file in the Director's office for 142 of these projects. It should be noted that a few of the projects outlined do

not represent investigation in the strict sense of the term, but are outlined for the purpose of having a permanent record of the activity involved. A list of the projects on which progress has been made during the year follows:

No. 5. The Immunization of Calves to Tuberculosis with "Bovovaccine." By C. M. Haring and R. M. Bell reporting to C. M. Haring. Suggested June 14, 1913.

No. 7. Toxicity of Insecticides (a) Insecticide Coefficients: Accuracy of Feeding of Testing Arsenicals. By C. W. Woodworth, Berkeley.

No. 16. A Systematic Study of the Important, So-called Physiological Diseases of Plants Occurring in California. By Ralph E. Smith, S. S. Rogers, Wyatt W. Jones and A. Boncquet reporting to Ralph E. Smith; at Berkeley and various field stations; Van Nuys and Roosevelt (Internal Brown Streak of Potato); Oroville (Exanthema); Stockton and vicinity (Little Leaf). Begun July 1, 1913.

No. 24. A Study of Causes and Means of Preventing the Spread of Tuberculosis in Cattle and Hogs in California. By C. M. Haring, C. L. Roadhouse and Ralph M. Bell, reporting to C. M. Haring. Suggested June 14, 1913. At Berkeley and elsewhere in California.

No. 25. A Chemical, Biological and Physiological Study of Alkali in Soils, in its Relations with Crop Production. By L. T. Sharp, reporting to Charles B. Lipman; at Davis, Berkeley, Kearney Park. Begun August, 1913.

No. 26. A Study of the Effects of Irrigation on the Physical, Chemical and Bacteriological Condition of Imperial Valley Soils. By P. S. Burgess, reporting to Charles B. Lipman; at Berkeley and Holtville. Begun January, 1913.

No. 27. A Continuation of Past Studies on the Effects of Salts of the Heavy Metals on Plant Growth. By W. F. Gericke, reporting to Charles B. Lipman; at conservatory and laboratories at Berkeley. Begun March, 1912.

No. 28. A Continuation of Past Studies on the Lime-Magnesia Ratio for Plants, Particularly Oranges. By W. F. Gericke, reporting to Charles B. Lipman; at Berkeley. Begun August, 1911.

No. 29. Studies on Soil inoculation with Non-Symbiotic Nitrogen Fixing Bacteria on Cropped and Uncropped Soils. By P. S. Burgess, reporting to Charles B. Lipman; at conservatory and laboratory in Berkeley. Begun September, 1913.

No. 30. Fundamental Studies on the Antagonism Between Salts as Measured by Bacterial Efficiency in Soils. (Continuation of past studies). By P. S. Burgess, reporting to Charles B. Lipman. Begun December, 1908.

No. 31. Determination of the Amounts of Nitrogen Fixed by Leguminous Cover Crops in California, Particularly in Orchards. By W. F. Gericke, reporting to Charles B. Lipman, at Davis and co-operatively in other orchards. Begun November, 1913.

No. 32. A Study of the Bacterial Flora of Soils on which Dieback in Citrus Trees Occurs, to Determine Whether or not any Relation Exists Between the Bacterial Flora of the Soil and the Diseased Condition. By P. S. Burgess, reporting to Charles B. Lipman. Begun July, 1912.

No. 33. Continuation of Studies on the Bacterial Flora of California Soil Columns to Complete the Comprehensive Physical, Chemical, and Biological Studies Started Some Years Ago at this Station. By P. S. Burgess and W. F. Gericke, reporting to Charles B. Lipman, at Berkeley and various important soil regions in California. Begun December, 1908.

No. 34. Co-operative Experiments in the Control of Bovine Tuberculosis. By Ralph Bell, reporting to C. M. Haring; at Berkeley and elsewhere in California. Begun August 8, 1913.

No. 35. Toxicity of Insecticides (a) Insecticide Coefficients: Comparison of Formalin and Arsenic for Flies. By C. W. Woodworth, Berkeley.

No. 38. Toxicity of Insecticides (a) Insecticide Coefficients: Study of Action of Constant Strengths of Cyanide on Insect Eggs. By C. W. Woodworth, Berkeley.

No. 39. Toxicity of Insecticides (b) Physical Variations: Strength of Tent Material to Determine Specifications for Weavers which will Give Best Compromise Between Strength and Tightness. By C. W. Woodworth, Berkeley.

No. 40. Toxicity of Insecticides (b) Physical Variations. Study of Gas Density in Fumigation. By C. W. Woodworth, Berkeley.

No. 41. Toxicity of Insecticides (b) Physical Variations. Nozzle Testing. Construction of Formulae for Nozzle Construction to Obtain any Desired Performance. By C. W. Woodworth, Berkeley.

No. 42. Toxicity of Insecticides (b) Physical Variations. Cause of Fumigation Injury. By C. W. Woodworth, Berkeley.

No. 43. Toxicity of Insecticides (c) Specific Variation Action of Various Arsenicals on Plants and Insects. By C. W. Woodworth, Berkeley.

No. 44. Toxicity of Insecticides (c) Specific Variation. Action of Petroleum Distillates on Plants. By C. W. Woodworth, Berkeley.

No. 45. Toxicity of Insecticides (c) Specific Variation of Cyanide on Different Scale Insects. By C. W. Woodworth; at Berkeley and Southern California.

No. 47. Toxicity of Insecticides (d) Physiological Variation. Respiration Losses as a Method of Recording Physiological Disturbance Due to Insecticides. By C. W. Woodworth, Berkeley.

No. 49. Toxicity of Insecticides (d) Physiological Variation. Relation of Temperature Changes to Longevity. By C. W. Woodworth, Berkeley.

No. 50. Toxicity of Insecticides (d) Physiological Variation. Progress of Poisoning as Determined by Intervitem Staining. By C. W. Woodworth, Berkeley.

No. 51. Reclamation of Alkaline Lands by Flooding and Tile Drainage. Work done co-operatively by the Division of Soil Technology, University of California, and the Division of Drainage Investigations, Office of Experiment Stations, United States Department of Agriculture, at Fresno, California, S. E. ¼, Sec. 6, T 148, R 19 E. By C. F. Shaw and W. W. Weir, reporting to Charles F. Shaw. Begun June 9, 1913.

No. 52. Hog Cholera, its Prevalence and Prevention in the Imperial Valley. By W. J. Taylor, reporting to C. M. Haring; at Imperial Valley. Suggested June 14, 1913.

No. 53. Concentration of Hog Cholera Serum and the Precipitation of the Immune Bodies. Work done co-operatively by J. F. Mitchell and C. H. McCharles of the Nutrition Division, reporting to C. M. Haring; at Budd Hall and Veterinary Science Laboratory. Begun June 1, 1913.

No. 54. Miscellaneous Investigations Concerning Live Stock Losses in the Imperial Valley. By W. J. Taylor, reporting to C. M. Haring; at Imperial Valley. Suggested June 14, 1913.

No. 55. Technical Improvements in the Manufacture of Hog Cholera Serum and Virus. By J. F. Mitchell, reporting to C. M. Haring; at Veterinary Science Laboratory and Hog Serum Laboratory, Berkeley. Suggested June 14, 1913.

No. 56. Improvements in the Dosage and Administration of Hog Cholera Serum and Virus. By J. F. Mitchell, reporting to C. M. Haring. Begun July 1, 1913.

No. 57. Studies upon the Bacterial Purity of Anti-Hog Cholera Serum Produced by the Various State Stations and Commercial Firms and upon Better Methods of Preserving Our Serum. By F. M. Hayes, reporting to C. M. Haring; at Veterinary Science Laboratory. Begun June 16, 1913.

No. 58. The Determination and Significance of the Spirochaeta Present in the Blood of Hogs Infected with Hog Cholera. By F. M. Hayes, reporting to C. M. Haring, at Veterinary Science Laboratory. Begun July 25, 1913.

No. 59. A Record of the Results of Hog Cholera Immunization at the University Farm. By F. M. Hayes, reporting to C. M. Haring. Begun April, 1913.

No. 60. Experiments Concerning the Bacterial Content of Milk, Skimmilk and Cream. By C. L. Roadhouse and R. S. Adams, reporting to C. M. Haring; at Veterinary Science Laboratory and University of California Dairy. Begun August 19, 1913.

No. 61. Certified Dairy Inspections. By C. L. Roadhouse and G. K. Cooke, reporting to C. M. Haring; at various certified dairies. Suggested June 14, 1913.

No. 62. Tuberculin Testing of Cows in Certified Dairies. By C. L. Roadhouse, reporting to C. M. Haring. Suggested June 14, 1913.

No. 63. Bacteriological Examination of Certified Milk. By C. L. Roadhouse et al, reporting to C. M. Haring; at Veterinary Science Laboratory. Suggested June 14, 1913.

No. 64. Drainage of Irrigated Lands by Pumping from Sump, without Tile. By W. W. Weir and L. K. Marshall, reporting to Chas. F. Shaw. Work located at Fresno, California, Experiment Station Tract. Begun September 30, 1913.

No. 65. A Study of the Effects of Liming and Inoculating Lima Bean Soils of Santa Barbara County on the Yield and Protein Content of Lima Beans. By Charles B. Lipman. At Stow Ranch near Goleta, California, and Dixey Thompson Ranch, about four miles from Santa Barbara. Begun February 1, 1913.

No. 66. A Continuation of Studies on the Effects of Temperatures of Irrigation Water on the Development of Orange Trees. By W. F. Gericke, reporting to Charles B. Lipman; at conservatory at Berkeley. Begun July, 1911.

No. 67. Investigation of the Moisture Content and Fertilizing Value of the Principal Kelps Found on the Coast of California. By Guy R. Stewart, reporting to J. S. Burd; field work at La Jolla and the vicinity of Monterey, laboratory work at Berkeley. Suggested August 15, 1913.

No. 68. The Use of Supplemental Feed with Barley for Pork Production. By J. I. Thompson, reporting to Gordon H. True, at University Farm, Davis. Begun July 1, 1913.

No. 69. Comparison of Lard Hogs with Bacon Hogs for Production of Bacon. By J. I. Thompson, reporting to Gordon H. True, at University Farm, Davis. Begun July 1, 1913.

No. 70. A Feeding Experiment to Determine the Value of Ground Barley as a Supplement to Alfalfa in the Feeding of Dairy Cows. By E. C. Voorhies, reporting to Gordon H. True, at University Farm, Davis, Calif. Begun August 6, 1913.

No. 71. Studies in Beef Production: the Feeding of Beet Pulp with Various Supplementary Feeds. By Gordon H. True; at Bloomfield Ranch of Miller & Lux, Gilroy, California. Begun October 24, 1913.

No. 72. Studies Concerning Infectious Abortion. By W. J. Taylor, reporting to C. M. Haring, at Imperial Valley. Suggested June 14, 1913.

No. 73. Investigation to Find the Relative Values of Soy Bean Meal, Meatscrap, Buttermilk and O. P. Linseed Oil Meal as High Protein Feeds for Laying and Breeding Hens. By J. E. Dougherty; at University Farm, Davis. Begun November 15, 1913.

No. 76. Metabolic Experiments with Young Poultry. Wheat Protein Experiments. By M. E. Jaffa and C. H. McCharles, reporting to M. E. Jaffa, Budd Hall, Berkeley. Begun August, 1913.

No. 78. Variety Trials of Grain. By W. E. Packard, reporting to J. W. Gilmore, at Imperial Valley (Experiment Station). Suggested August 25, 1913.

No. 79. Crop Production and Soil Management in Relation to Climatic Conditions in Imperial Valley. By Walter E. Packard, reporting to J. W. Gilmore, at Imperial Valley. Suggested July 28, 1913.

No. 80. Continuous Plantings and Biennial Cropping. By W. E. Packard, reporting to J. W. Gilmore, at Imperial Valley (Experiment Station). Suggested August 25, 1913.

No. 81. Rotations. By W. E. Packard, reporting to J. W. Gilmore; at Imperial Valley (Experiment Station). Suggested August 25, 1913.

No. 82. Crop Production and Soil Management in Relation to Soil Type at Imperial Valley Station. By Walter E. Packard, reporting to J. W. Gilmore. Suggested July 28, 1913.

No. 84. Miscellaneous Plantings. By W. E. Packard, reporting to J. W. Gilmore; at Imperial Valley Experiment Station. Suggested August 25, 1913.

No. 85. Comparison of Three Varieties of Alfalfa. By W. E. Packard, reporting to J. W. Gilmore; at Imperial Valley Experiment Station. Suggested August 25, 1913.

No. 86. Culture Methods for Alfalfa when used for (1) Pasture; (2) Hay Production. By W. E. Packard, reporting to J. W. Gilmore; at Imperial Valley Experiment Station. Suggested August 25, 1913.

No. 88. Veterinary Survey of Selby Smelter Zone for the Selby Smelter Commission. (In co-operation with Dr. K. F. Meyer of Pathology Department). By K. F. Meyer, C. M. Haring, and Wm. La Grange. Between Vallejo and Benicia; pathological work at Berkeley. Begun October 28, 1913.

No. 89. Walnut-Oak Hybrids: Study of a new form of Juglans Californica; Teratology in Juglans Californica; Allied Problems. By E. B. Babcock; at Berkeley, Garden Grove, and possibly other points in California. Begun March, 1908.

No. 90. A Study of the Value of Corn Silage as a Supplement to Alfalfa Hay. By F. W. Woll and Edwin C. Voorhies, reporting to Gordon H. True; at University Farm, Davis. Begun November 24, 1913.

No. 91. Metabolism of Fresh Milch Cows. By F. W. Woll and Edwin C. Voorhies, reporting to Gordon H. True; at University Farm, Davis. Suggested October 15, 1913.

No. 92. A Study of the Effects of Alfalfa as Exclusive Food in the Development of the Dairy Calf and Heifer for Dairy Purposes. By F. W. Woll and Edwin C. Voorhies, reporting to Gordon H. True. Suggested November 18, 1913.

No. 93. Studies in Beef Production: the Feeding of Various Grain Feeds in Connection with Alfalfa Hay for Range Steers. By Gordon H. True and F. W. Woll, reporting to Gordon H. True. At Riverside Ranch of the Western Meat Company at Lovelock, Nevada. Begun November 13, 1913.

No. 94. Breeding Experiments with Bulbous Plants. By H. E. Gilkey, reporting to E. B. Babcock; at Berkeley. Begun November, 1912.

No. 95. Studies on the Relative Availability of Nitrogenous Fertilizers for Oranges, Lemons, and Sugar Beets. By P. S. Burgess, reporting to Charles B. Lipman; at Spreckles and Oxnard for beets; the Phalanx Ranch, Exeter, for oranges; and the Spaulding Ranch, Sespe, for lemons. Begun March, 1912.

No. 96. Improvement of Bearing of Vine Varieties by Selection. By F. Flossfeder, reporting to Frederic T. Bioletti; at Davis. Begun 1910.

No. 97. Tests of New or Little Known Varieties of Vines. By F. Flossfeder, reporting to Frederic T. Bioletti; at Davis. Begun 1910.

No. 98. Resistant Stocks for Californian Vines. By F. Flossfeder, reporting to Frederic T. Bioletti; at Davis. Begun 1910.

No. 99. Effects of Early and Late Pruning of Vines. By F. Flossfeder, reporting to Frederic T. Bioletti; at Davis and elsewhere. Begun November, 1911; finished December, 1912.

No. 100. Disinfection of Roots and Cuttings with Hot Water. By F. Flossfeder, reporting to Frederic T. Bioletti; at Davis. Begun March, 1911; finished May 23, 1913.

No. 103. Relation of Degree of Maturity of Grapes to Quantity and Quality of Raisins. By A. E. Way, reporting to Frederic T. Bioletti; at Kearney. Begun August, 1913.

No. 104. Resistant Stocks for Raisin Varieties. By A. E. Way, reporting to Frederic T. Bioletti; at Kearney. Begun 1911.

No. 105. Wine Grapes for the San Joaquin Valley. By A. E. Way, reporting to Frederic T. Bioletti; at Kearney. Begun 1911.

No. 106. Varieties and Methods Suitable for Grape Growing in Imperial Valley. By W. E. Packard, reporting to Frederic T. Bioletti, at University Experiment Station, Meloland, Imperial County. Begun 1911.

No. 108. Coating for Cement Wine Vats. By W. V. Cruess, reporting to Frederic T. Bioletti; at Berkeley. Begun January, 1913.

No. 109. Amounts of Wine and By-Products Yielded by Grapes in California. By W. V. Cruess, reporting to Frederic T. Bioletti; at Berkeley and Martinez. Begun September, 1913.

No. 110. Improvement of Methods of Preparing Unfermented Grape Juice. By W. V. Cruess, reporting to Frederic T. Bioletti; at Berkeley and Martinez. Begun August, 1913.

No. 111. Standards of Composition of California Grapes and Wine. By W. V. Cruess, reporting to Frederic T. Bioletti; at Berkeley. Begun December, 1913.

No. 112. Improvements of the Methods of Vinegar Making in California. By W. V. Cruess, reporting to Frederic T. Bioletti; at Berkeley, Watsonville, Sebastopol, etc. Begun September, 1912.

No. 113. Methods of Germinating Olive Seeds. By W. F. Oglesby, reporting to Frederic T. Bioletti; at Berkeley. Begun March, 1913.

No. 114. Preparation of Collection of Olive Trees at Davis, Kearney and Imperial and of Specimens at Berkeley. By W. F. Oglesby, reporting to Frederic T. Bioletti; at Berkeley and Davis. Begun March, 1913.

No. 115. Improvement of Methods of Pickling Olives. By W. F. Oglesby, reporting to Frederic T. Bioletti; at Berkeley. Begun December, 1913.

No. 116. A Study of Armillaria Mellea: with the Purpose of Finding Practicable Ways to put an End to Loss from this Fungus Among Trees and Shrubs. By W. T. Horne, reporting to Ralph E. Smith; at Berkeley, Fairoaks, San Jose, and other places. This is former Plant Pathology Project No. 8, commenced in previous years.

No. 117. Minor Investigations in Plant Pathology. By Elizabeth H. Smith, reporting to Ralph E. Smith; various places. Continuation of former work.

No. 118. A Study of Bacterial Disease of Olives known as Olive Knot, with the Purpose of Discovering the Method of Dissemination of the Causative Organism and the Conditions Governing Inspection, the Perfecting of a Practical Method of Control or Eradication and Study of the Pathological Changes Connected with the Knot Formation. By W. T. Horne, reporting to Ralph E. Smith; at Berkeley and Fair Oaks. Former Plant Pathology Project No. 10, commenced in previous years.

No. 119. Improvement of the Walnut Industry, Based Particularly Upon Control or Avoidance of Blight and Other Diseases. By Ralph E. Smith and S. S. Rogers, reporting to Ralph E. Smith; in various parts of the State. Continuation of previous investigations.

No. 120. Demonstration of Improved Methods of Enology: in Co-operation with the Extension Division. By W. V. Cruess, reporting to Frederic T. Bioletti.

No. 122. A Study of the Factors Influencing Seed Formation in Citrus Fruits. By J. Eliot Coit and Carl Nichols, reporting to J. Eliot Coit; at Commercial Orange and Lemon Orchards near Whittier and Riverside, Berkeley. Other places to be decided upon. Begun April 10, 1911.

No. 123. The Loquat. By Ira J. Condit, reporting to J. Eliot Coit. Begun February 1, 1914.

No. 124. Studies of the Feed Requirements and Milk Production of Milch Goats: (a) on the Value of Grain Feeds for Goats fed Alfalfa Hay. By F. W. Woll and E. C. Voorhies, reporting to Gordon H. True, University Farm, Davis, California. Suggested December 29, 1913.

No. 127. Insect Industries (b) Silkworms. Overcoming Dependence on Mulberry. By L. J. Nickels, reporting to C. W. Woodworth. Berkeley and Davis.

No. 131. Life Histories (a) Insects on Agricultural Crops. Cut Worms. By C. W. Woodworth, Berkeley.

No. 132. Life Histories (a) Insect Pests on Agricultural Crops. Minor Insects. By C. W. Woodworth, Berkeley.

No. 137. Life Histories (a) Insects on Agricultural Crops. Citrus Insects. By H. J. Quayle, reporting to C. W. Woodworth; Southern California.

No. 142. Life Histories (b) Forest Insects. Forest and Shade Tree Insects and Their Relation to the Diseases Affecting Such Trees. An effort to determine specifically for each of our native forest trees, the exact effect of each species of insects attacking them upon the physiology of the trees and just what insects may be responsible for death of trees. By Geo. A. Coleman, reporting to C. W. Woodworth; University of California campus; forest areas of Bay region; vicinity of Santa Barbara, and other localities in the State where the condition of the trees may require an investigation. Suggested January 1, 1914.

No. 151. Toxicity of Insecticides (a) Microscopical Identification of Components of Insect Powders. By C. W. Woodworth, Berkeley.

No. 158. The Pollination of Domestica and Triflora Plums Under California Conditions. By A. H. Hendrickson, reporting to B. B. Pratt. Location of the work at University Farm, Davis, California, and commercial orchards in representative sections of the State. Suggested January 22, 1914.

No. 159. Student Laboratory Plantings—a Study of Fruit Tree Stocks, Pruning and Planting Methods. By members of the teaching staff, reporting to B. B. Pratt; University Farm, Davis. Suggested February 4, 1914.

No. 160. Death of Animals and Cases of Serious Sickness at University Farm. By F. M. Hayes, reporting to H. E. Van Norman. Begun January 9, 1914.

No. 161. Weekly Report of Work in Progress at University Farm by Farm Division, Repairs and Power Division and Grounds. By T. Tavernetti, reporting to H. E. Van Norman. Suggested January 6, 1914.

No. 162. A Comparative Efficiency Test of Orchard Heating Devices. By W. W. Bonns and W. M. Mertz in co-operation with Dr. L. J. Briggs and J. W. McLane, U. S. D. A., reporting to H. J. Webber. Location of the work on or near grounds of the Citrus Experiment Station, Riverside, and such other locations as may prove desirable in the development of the work. Begun December 1, 1913.

No. 163. Reconnaissance Soil Survey of Sacramento Valley Areas, California. By J. W. Nelson and party, reporting to C. F. Shaw; Sacramento Valley, California, from Red Bluff south, below Suisun Bay (from 38° to 40° 15′ N) and from the foothills on the west of the hills on the east. Begun July 1, 1913; concluded February 14, 1914.

No. 164. Soil Survey of Southern California. By J. W. Nelson and party reporting to C. F. Shaw; Southern California between the Pacific Ocean and the 116° 30′ W meridian and between the Mexican boundary and 30° 30′ N parallel of latitude. Begun February 1, 1914.

No. 166. Effect of the Use of Various Fertilizers on a Vineyard Growing in a Good Well-balanced Soil. (In co-operation with the Divisions of Soils and Fertilizers). By F. T. Bioletti.

No. 167. Irrigation Investigations, Duty of Water, Field Crops. Tank Work and Measuring Devices. By S. H. Beckett, reporting to Frank Adams; University Farm, Davis. Begun spring, 1910.

No. 168. Influence of Rotation upon Crop Producing Power of the Soil Without Treatment. By L. K. Marshall, reporting to J. W. Gilmore, Kearney Park, Fresno, California. Suggested 1909.

No. 171. The Study of the Efficiency of the Hinman Milking Machine. By F. W. Woll and Thos. E. Cooper, reporting to Gordon H. True. Location of the work at University Dairy Barn, University Farm, Davis, California. Suggested January 24, 1914.

No. 173. Fertilizer Experiment. By B. A. Madson, reporting to J. W. Gilmore; University Farm, Davis, California. Continuation of work of several years past. To be completed 1914 or 1915.

No. 174. Rotation Experiments. By B. A. Nelson, reporting to J. W. Gilmore; at University Farm, Davis, California. Begun November, 1913.

No. 175. Seed Exchange Experiment. By B. A. Madson, reporting to J. W. Gilmore; at University Farm, Davis, California. Continuation of work begun in 1907.

No. 176. Variety Trials with Wheat, Barley and Oats in Plots. By B. A. Madson, reporting to J. W. Gilmore; University Farm, Davis, California. Continuation of work carried on for a number of years.

No. 178. The Effects of Frost on Vines and Methods of Control. By Leon O. Bonnet, reporting to Frederic T. Bioletti; Berkeley. Suggested March 4, 1914.

No. 179. Comparative Cost of Hand Milking vs. Machine Milking in Commercial Dairies. By Edwin C. Voorhies, reporting to Gordon H. True. As many places in California as possible. Suggested March 1, 1914.

No. 183. Investigation of the Agricultural Value of the Major Fertilizing Constituents of Kelp: Nitrogen and Potash. By G. R. Stewart and others, reporting to John S. Burd. Begun January 1, 1914.

No. 184. Maintenance of Forage Supply in the Mountain Regions of California. By P. B. Kennedy, reporting to J. W. Gilmore. Six tracts not yet selected, in mountains of California. Suggested March 9, 1914.

No. 186. The Practicability of Growing Vegetables on the University Farm. By S. S. Rogers, reporting to H. E. Van Norman; University Farm, Davis. Begun January 1, 1914.

No. 187. Almond Culture. By R. H. Taylor, reporting to B. B. Pratt. Work carried on at the University Farm, Davis, California, and commercial orchards in representative districts. Suggested April 14, 1914.

No. 190. Cross-Breeding Peaches with Reference to (1) Improved Fruits, (2) Improved Rootstocks, (3) Study of Inheritance in Amygdalus. By E. B Babcock, R. E. Clausen, and others, reporting to E. B. Babcock. Begun February, 1909 (at Whittier); 1914 at Berkeley.

No. 191. A Study of the Fertilizer Requirements of Citrus Fruits. By H. J. Webber, W. M. Mertz, et al; at the Citrus Experiment Station, Riverside, California. Begun April, 1907.

No. 192. Green Manure Crops for Southern California: with Special Reference to Their use in Citrus Orchards. By W. M. Mertz, reporting to H. J. Webber; at Citrus Experiment Station, Riverside, California. Begun September 1, 1909.

No. 193. The Effect of Different Stocks on Commercial Species and Varieties of Citrus. By W. W. Bonns and W. M. Mertz, reporting to H. J. Webber. Series 1, Citrus Experiment Station, Riverside; Series 2, new site of Citrus Experiment Station and elsewhere as nature of work proves desirable. Begun April, 1907.

No. 194. A Study of the Varieties of Citrus Fruits and Their Relatives. By H. J. Webber, W. M. Mertz, H. B. Frost, et al, reporting to H. J. Webber. Citrus Experiment Station, Riverside, California. Begun February 1, 1913.

No. 195. A Comparative Efficiency Test of Orchard Heating Devices. By W. W. Bonns and W. M. Mertz in co-operation with Dr. L. J. Briggs and J. W. McLane, U. S. D. A., reporting to H. J. Webber. Work carried on on or near grounds of the Citrus Experiment Station, Riverside, and such other locations as may prove desirable in the development of the work. Begun December 1, 1913.

No. 197. Study of the Comparative Infectiousness of the Crown Gall Organism (Bacterium tumefaciens), with Special Reference to Finding Resistant Forms of Prunus Suitable as a Rootstock for the Various Stone Fruits. By C. O. Smith, reporting to H. J. Webber. Work carried on at Whittier, California. Begun March, 1910.

No. 198. Lemon Decay Fungi, with Special Reference to Their Control by Washwater Disinfection. By C. O. Smith and E. E. Thomas reporting to H. J. Webber. Work carried on at Whittier, California, as headquarters, with experiments and observation over all of Southern California. Begun April 8, 1911.

No. 199. Black Pit of Lemons. By Clayton O. Smith reporting to H. J. Webber. Work carried on at the Whittier Pathological Laboratory. Begun May, 1912; concluded July, 1913.

No. 250. Investigations as to the Causes, Manner of Development, and Treatment of Gum Diseases of Citrus and Other Fruit Trees. By H. S. Fawcett reporting to H. J. Webber. Work carried on at Whittier, Santa Paula, Chula Vista, Riverside, and other places. Begun February, 1912.

No. 251. Investigations as to the Cause and Treatment of Melakuma of English Walnut Trees. By H. S. Fawcett reporting to H. J. Webber. Work carried on at Whittier, Santa Barbara, and Ventura in co-operation with Mr. C. W. Beers, County Horticultural Commissioner of Santa Barbara County. Begun June, 1913.

No. 252. Routine Examination of Material Sent to the Citrus Experiment Station, and Minor Studies in Mycology and Bacteriology. By J. T. Barrett, C. O. Smith, and H. S. Fawcett reporting to H. J. Webber. Work carried on at Riverside and Whittier. Begun 1909.

No. 253. Some Studies of Mottling of Citrus Trees. By J. T. Barrett reporting to H. J. Webber. Work carried on at Riverside and various other locations. Begun April, 1914.

No. 257. A Study of the Horticultural Conditions in Florida, Cuba, and the Isle of Pines, with Special Reference to Citrus Culture. By H. S. Fawcett reporting to H. J. Webber. Work carried on at Florida, Cuba, and the Isle of Pines. Begun January 5, 1914; concluded March 1, 1914.

No. 258. The Nematode Problem on Citrus Trees. By E. E. Thomas reporting to H. J. Webber. Work carried on at Whittier, Riverside, and various points in Southern California. Begun December, 1912.

No. 259. A Study of Enzymes in Connection with Plant Diseases. By H. D. Young reporting to H. J. Webber. Work carried on at Whittier, California. Begun October, 1912.

No. 260. A Study of the Relative Influence of Different Factors on the Composition of Certain Fruits and Nuts. By H. D. Young reporting to H. J. Webber. Work carried on at Riverside and Whittier. Begun January, 1913.

No. 261. The Breeding and Improvement of Citrus Fruits. By H. J. Webber and H. B. Frost in co-operation with A. D. Shamel, U. S. Department of Agriculture, reporting to H. J. Webber. Work carried on at Riverside, Cal. Begun July, 1914.

No. 262. The Principles of Heredity in Certain Plants. By H. B. Frost reporting to H. J. Webber. Work carried on at the Citrus Experiment Station, Riverside. Begun October, 1913.

No. 263. The Origin, Nature, and Inheritance of Apparent Mutations in Certain Plants. By H. B. Frost reporting to H. J. Webber. Work carried on at the Citrus Experiment Station, Riverside. Begun October, 1913.

No. 264. The Comparative Value of Various Paints, Waxes, and Antiseptic Washes as Treatment for Wounds on Citrus Trees. By W. M. Mertz reporting to H. J. Webber. Work carried on at the Citrus Experiment Station, Riverside, in variety orchard. Begun April 26, 1913.

No. 266. A Study of the Freeze of January, 1913. By H. J. Webber, C. S. Milliken, A. R. Tylor, et al. reporting to H. J. Webber. Work carried on in Southern California with headquarters at Riverside. Begun January 20, 1913; concluded April, 1912.

No. 267. A Study of the Methods for the Determination of Sulphur Dioxide in Dried Fruits. By M. E. Jaffa.

Some indication of the scope of the investigations may be obtained by summarizing these investigations by divisions. The number of investigations, however, does not necessarily indicate the investigational activities of a division, since the work devoted to different projects necessarily varies greatly:

Division of Agronomy	14 projects
Division of Animal Husbandry	11 projects
Division of Citriculture	2 projects
Citrus Experiment Station	22 projects
Fertilizer Control Division	2 projects
Division of Genetics	3 projects
Irrigation Investigations	1 project
Division of Nutrition	2 projects
Division of Plant Pathology	5 projects
Division of Pomology	3 projects
Division of Poultry	1 project
Division of Soil Chemistry and Bacteriology	12 projects
Division of Soil Technology	4 projects
Division of Veterinary Science	17 projects
Division of Viticulture	20 projects
Division of Entomology	19 projects
University Farm	3 projects
	141 projects

RESEARCH AND POPULARITY NOT ASSOCIATED

The public has been very responsive to the Department's instructional work, made possible by the researches of my distinguished predecessors and their able associates. The man who has the ability to present to an audience in a clear and convincing manner the results of investigational work always obtains a satisfactory hearing. The man who understands the details of ordinary practice so as to relate the results of research to actual conditions is especially appreciated. Both types of men are very useful and very necessary to a successful Department of Agriculture. What all of us fail, however, sometimes to understand is that the men who actually extend the realm of knowledge and who, therefore, are in the last analysis the most useful servants of mankind perhaps rarely have any of these qualities. The men who made possible the building of the Panama Canal through their cloister-like researches on the life history of the yellow fever parasite may have been, from the standpoint of business, the most impracticable of men. The man who has done more than any other man in America to improve the dairy industry had this opportunity because the director of the station with which he was connected realized that research and popularity were not necessarily associated. The obvious difference in function between the men of research and the teacher or the men of direct public service creates a difficult administrative problem. The investigator who accomplishes most as an investigator must necessarily be much removed from the public mind. He may

spend a lifetime on a problem of the greatest moment and finally leave its proper solution to others. The quicker rewards of other types of service often lure the ambitious man away from his task. Fortunately, however, as recently stated by Dr. Brooks, "no person attains to the highest joys who shirks difficulties." The Director of the station appreciates that if he fails to realize the fundamental requirements of men of research or fails to protect them in the quiet and orderly transaction of their tasks, he will fail in his full duty to the cause of agricultural progress in California.

PUBLICATIONS

The following is a list of the publications of the Agricultural Experiment Station. Those marked with a star are no longer available for distribution. The reports, bulletins, and circulars of the Agricultural Experiment Station are, in accordance with the law, distributed free of charge to any citizen of the state requesting the same. The mailing list, at the present time, numbers 22,000 addresses:

		Edition
Report of the College of Agriculture and the Agricultural Experiment Station of the University of California from July 1, 1912 to June 30, 1913		25,000
Bull. 240.	Commercial Fertilizers. J. S. Burd	20,000
Bull. 241.	Vine Pruning in California, Part I. F. T. Bioletti	30,000
Bull. 242.	Humus in California Soils. R. H. Loughridge	30,000
Bull. 243.	The Intradermal Test for Tuberculosis in Cattle and Hogs. C. M. Haring	30,000
Bull. 244.	Utilization of Waste Oranges. W. V. Cruess	15,000
	Total	150,000
Cir. 104.*	The Amended Insecticide Law. C. W. Woodworth	2,500†
Cir. 105.*	Analyses of Insecticides for Users. C. W. Woodworth	1,000†
Cir. 106.	Directions for Using Anti-Hog Cholera Serum. J. F. Mitchell	25,000
Cir. 107.	Spraying Walnut Trees for Blight and Aphis Control. R. E. Smith	8,000
Cir. 108.	Grape Juice. F. T. Bioletti	8,000
Cir. 109.	Community or Local Extension Work by the High School Agricultural Department. W. G. Hummel	15,000
	Carried forward	59,500

† Not generally distributed.

	Brought forward	59,500
Cir. 110.	Green Manuring in California. C. B. Lipman	30,000
Cir. 111.	The Use of Lime and Gypsum on California Soils. C. B. Lipman	30,000
Cir. 112.	The County Farm Adviser. B. H. Crocheron	30,000
Cir. 113.	Announcement of Correspondence Courses in Agriculture. W. G. Hummel	40,000
Cir. 114.	Increasing the Duty of Water. B. A. Etcheverry	30,000
Cir. 115.	Grafting Vinifera Vineyards. F. T. Bioletti	15,000
Cir. 116.*	Silkworm Experiments. C. W. Woodworth	20,000
Cir. 117.	The Selection and Cost of a Small Pumping Plant. B. A. Etcheverry	30,000
	Total	284,500

The University of California Publications which bear on subjects relating to agriculture are issued in editions of 1000. The price charged for each is given below:

Volume I.		Price
No. 1.	The Distribution and Activities of Bacteria in Soils of the Arid Region. Chas. B. Lipman	.30
No. 2.	Studies on the Phenoldisulphonic Acid Method for Determining Nitrates in Soils. Chas. B. Lipman and L. T. Sharp	.15
No. 3.	The Effects of Calcium and Magnesium Carbonates on some Biological Transformations of Nitrogen in Soils. W. P. Kelley	.10
No. 4.	The Aluminum Reduction Method as Applied to the Determination of Nitrates in "Alkali" Soils. P. S. Burgess	.15
No. 5.	Studies upon Influences Affecting the Protein Content of Wheat. G. W. Shaw	.75
No. 6.	The Effect of Copper, Zinc, Iron, and Lead Salts on Ammonification and Nitrification in Soils. C. B. Lipman and P. S. Burgess	.15
No. 7.	Studies on Ammonification in Soils by Pure Cultures. C. B. Lipman and P. S. Burgess	.25

Volume II.		
No. 1.	Studies in Juglans I. Study of a New Form of *Juglans Californica* Watson. E. B. Babcock	.60
No. 2.	Studies in Juglans II. Further Observations on a New Variety of *Juglans californica* Watson and on Certain Supposed Walnut-Oak Hybrids. E. B. Babcock. (In press.)	

OCCUPATION OF GRADUATES

It is obvious that if instruction in Agriculture is to be worth while the graduates of the Agriculture College should have the opportunity of employing the training which they have received in a manner useful both to themselves and the state.

Statistics gathered from the agricultural students of the class of 1914 of this institution show that the total cost of the four years' course in agriculture was $1,792, and that of this amount each student earned by his own labor an average of $876, or 51 per cent of the whole. Only 22 per cent of these students owned farms or expected to inherit farms later. Like statistics were gathered from ten other universities. (See *Orange Judd Farmer,* May 30, 1914.)

The students in California earned the largest amount, although not the largest per cent of money, and had the least prospect so far as land or capital was concerned. In other words the students of this institution are more dependent upon securing employment for wages than those of any of the other ten institutions. Fortunately the opportunity for competent men to secure employment in agricultural pursuits in California is unexcelled.

Frequent demands for men trained technically reach this office. Graduates who have shown ability to assume responsibilities and handle men naturally are most in demand. Such men are quickly absorbed by the various activities of the state. However, in the past there has often been difficulty in finding suitable positions for graduates of less practical experience and promise. These latter men have not infrequently been drawn into non-agricultural positions where their horizon is not enlarged. The result has been that their earning power along the lines for which they were educated is not increased. Conse quently as these men grow older they are lost to agriculture and the dearth of competent experienced and trained men continues.

In an effort to correct this condition, prominent men closely in touch with agricultural conditions in this state were informed of the men about to be graduated. Nearly all the men addressed responded with such promptness that the supply of available men was quickly exhausted.

There are more than a score of desirable positions open at present for properly trained men that it has not been possible to fill.

The inexperienced graduates have been so placed this year that it is believed they will develop into valuable men and thus will not be lost to the state.

BUILDINGS AND OTHER BETTERMENTS

Fertilizer Control Annex.—The need for offices, classrooms, and laboratory space at Berkeley remains unabated. To meet the existing serious demand of the sophomore class for the laboratory work in agricultural chemistry and soils there is being constructed an annex to the Fertilizer Control Building, at an estimated cost, including equipment, of $10,000.

It is a wooden two-story building 33 feet 6 inches by 76 feet 6 inches, containing three instructional laboratories, each with a capacity of thirty to a section, and two small research laboratories.

Insectary.—There has been constructed for investigations in entomology, an insectary in accordance with the plans prepared by Professor Woodworth, head of the Division of Entomology, at a cost approximately of $870. This building and the grounds appertaining to it constitute the most elaborate equipment of its kind.

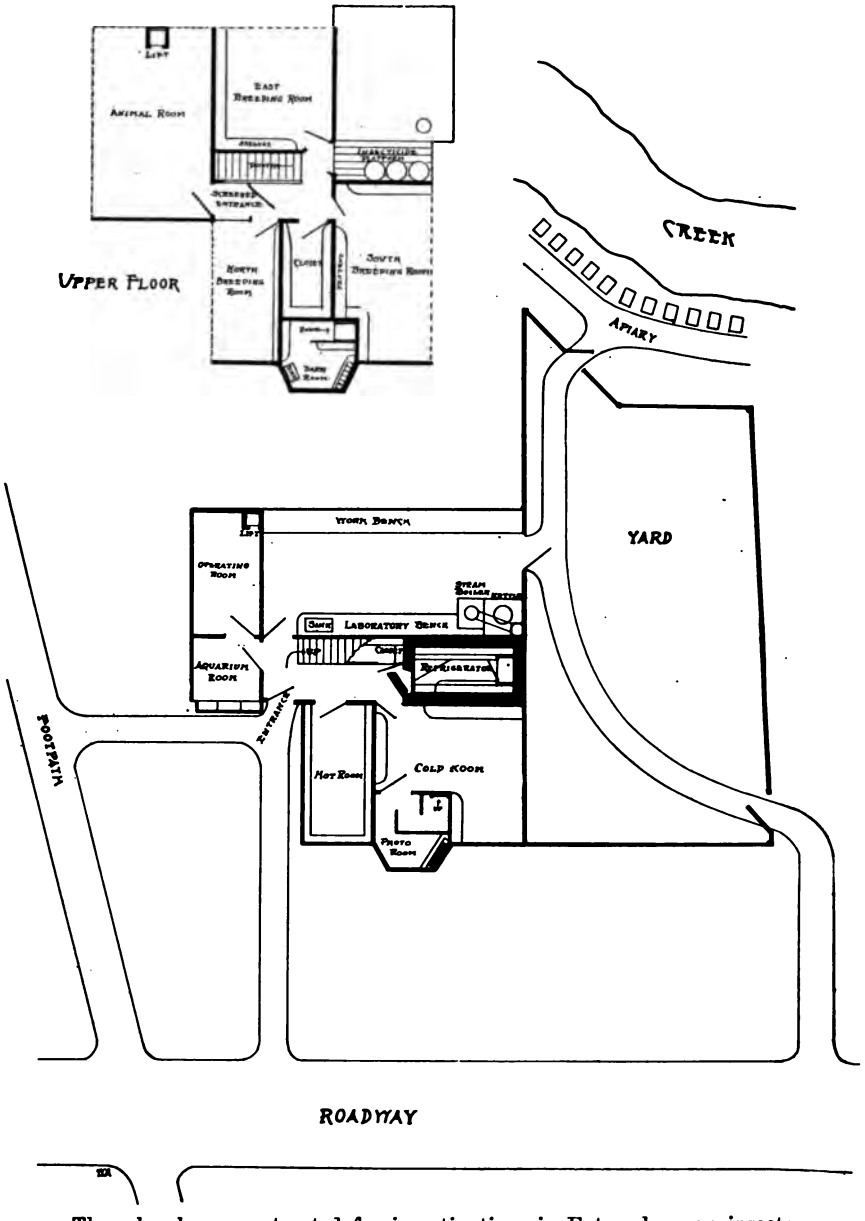
The Students' Apiary occupies a space about 50 feet long adjacent to the creek. The enclosure next to the building is now being used in a study of soil fumigants and has beds laid out around the edge for growing plants for the rearing of insects.

The largest laboratory room was used this spring as a workshop for the course in beekeeping and in the fall term will be used for that in insecticides. It is provided with a long workbench, with sink, a steam boiler and a large kettle mounted in masonry. The boiler furnishes steam for cooking insecticides along the bench and upstairs to a series of barrels on a platform, from which the preparation made may be delivered by gravity to the spray tank.

The equipment for the study of animal parasites consists of a large room enclosed in mosquito wire for keeping the animals. This has an entry way fully screened to prevent the access of flies. Connecting with the animal room above by an elevator is the operating room, one side of which is glass. Another side consists of closets for instruments and material.

Three wire enclosed rooms on the second floor are for the ordinary breeding work for plant pests. These have different exposures and therefore temperatures, and still greater variation is provided by two glass enclosed rooms on the first floor, one of which is to be kept at summer temperature by means of hot water pipes. Also on this floor a large refrigerator, taking a ton of ice, provides for studying the problems of hibernation.

An aquarium room provides the means of studying aquatic forms, including nine large aquaria, occupying an entire side of the room



There has been constructed for investigations in Entomology an insectary at a cost approximately of $870. This building and the ground appertaining to it constitute the most elaborate equipment of its kind.

and equally observable from the outside of the building. These aquaria are provided with a specially designed automatic aeration apparatus.

The photographing equipment consists of a set of five cameras supported vertically between posts independent of the building. They are arranged to five magnifications of ½, 1, 2, 4, and 8 times respectively; the distance from plate to photographic bench is ten feet, thus securing a great depth of focus. The upper ends of the camera are in the dark room on the second floor. The dark room attendant is apprised of the taking of a picture by a minute electric ruby light which is lit by the shifting of the focal-plane shutters. He can then remove the exposed plate and load the camera for another picture, setting the shutter, and thus notifying the operator below that the camera is again ready to use. The photographic bench is provided with openings corresponding to the surface covered by the plate, so that the proper camera to use for each subject can be determined without delay and each camera is focused on the surface of the bench, reducing the focusing of the object to the act of bringing it at bench level. The bench is enclosed beneath and provided with louvers, trapping out all direct light, making a perfectly black field. Label holders provide for placing the number on the plate and also indicate the magnification. The object of the whole equipment is to provide cameras which can be adjusted once for all with greatest care and with every provision for producing the best photograph, and then to keep them unchanged and reduce the time of taking the photographic record to the minimum limit.

Greenhouses and Experimental Grounds.—Two new greenhouses 28 feet 8 inches by 50 feet, divided into four equal units and accommodating the divisions of Agronomy, Citriculture, Genetics, Plant Pathology, and Viticulture, have been erected just east of Agriculture Hall. Including the modification of an old building for head house, about $2600 has been expended.

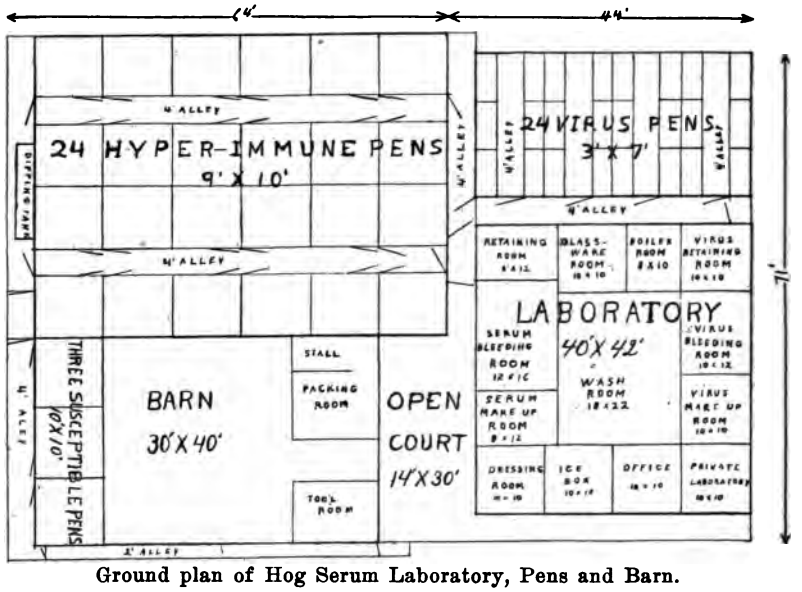
These houses used in investigational work make available space in the old greenhouse for instruction in floriculture and plant propagation. The department, however, still continues to need new greenhouses of modern type and construction suitable for research and student work.

These new houses should be located in harmony with the agriculture group, and be made a permanent part of the University plan. There is also the continued necessity of maintaining the present amount of outdoor nursery and garden space, as well as grounds for the investigations of the several divisions, notably genetics and agronomy.

Hog Serum Plant.—In the latter part of the year 1913 a new site was secured for the Hog Serum Laboratory located at the foot of Sixty-sixth avenue in East Oakland, and a building costing approxi-

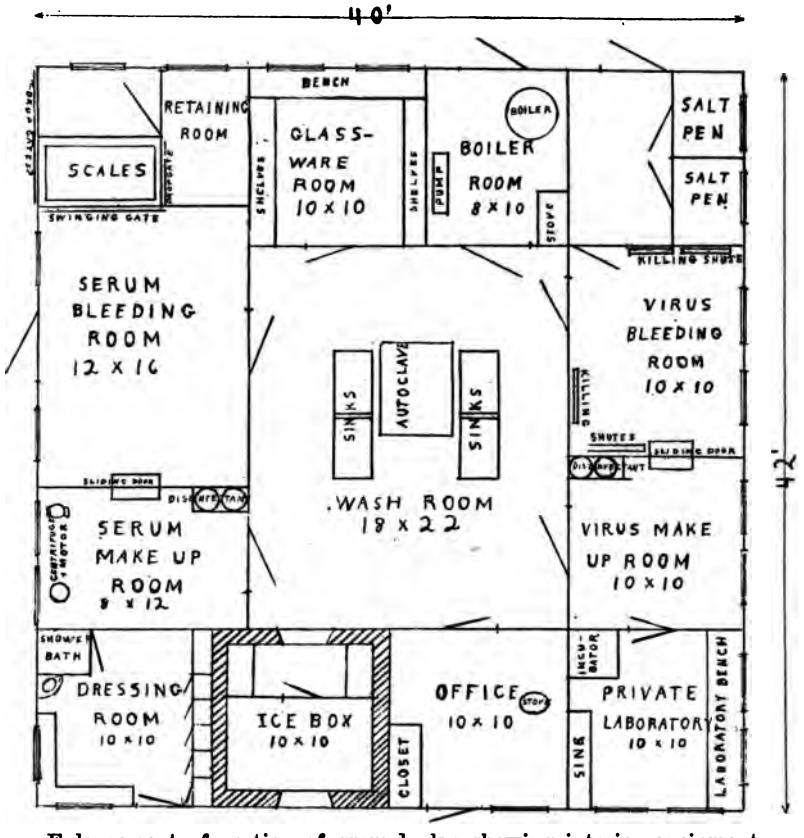
The University of California Hog Serum Plant at the foot of Sixty-sixth Avenue, Oakland.

mately $5000 was erected on piles over the tide land. This location made possible the use of salt water for flushing and keeping the entire plant in a thoroughly sanitary condition. Since the plant is adjacent



Ground plan of Hog Serum Laboratory, Pens and Barn.

to a railroad with spur track facilities, the cost of transporting the hogs and feed which are used at the laboratory has been reduced. An abattoir and rendering plant are near by. The virus hogs are sold to the rendering plant for fertilizer and the healthy hyperimmune hogs or those not susceptible to cholera are killed on commission at the abattoir and sold for pork at market prices.



Enlargement of portion of ground plan showing interior equipment of Hog Serum Laboratory.

About $1,500 has been used in the purchase of additional equipment, which makes it possible to produce the very best grade of serum. The laboratory is provided with cold storage facilities for storing serum at a low temperature. On pages 42–43 are shown ground plans, giving the location of the pens for susceptible, virus and hyperimmune hogs.

The plant has a total capacity of about 3,000,000 cubic centimeters annually. The building is constructed of wood, with cement floors, the walls and inside roof being painted white, thus making it possible to keep the plant clean. The serum is produced in one set of rooms, while the virus is prepared in an entirely separate section of the plant.

Classroom Buildings.—The classroom building, for which the Legislature appropriated $65,000, is being constructed at the University Farm. It is a brick and cement building, two stories and a basement. It is 152 feet by 91 feet 11 inches. The building contains an auditorium with a seating capacity of 640, and a library 54 by 32 feet. There is a room for social activities, seven classrooms, and eight offices, together with the usual subsidiary rooms and accommodations.

Three dormitories and dining hall at the University Farm. The dormitory on the left and the left half of the dining hall has been built during the present fiscal year.

Dormitory No. 3.—The third dormitory, for which the Legislature appropriated $40,000, has been erected at the University Farm during the year.

It is built of wood in harmony with the previous dormitories, consisting of a basement and three stories. The basement contains two rooms suitable for class purposes. The first floor contains a large living room, while the rest of this floor and the two floors above are devoted exclusively to dormitory purposes. There are seventy-two sleeping rooms estimated to accommodate ninety-nine persons. The following table shows the living accommodations in the three dormitories:

	Sleeping rooms	Present capacity	Maximum capacity
Dormitory No. 1	51	79	87
Dormitory No. 2	56	85	95
Dormitory No. 3	72	99	109
	179	263	291

Dining Hall Addition.—An appropriation of $10,000 for a permanent addition to the Dining Hall gives the dining room 36 by 150 feet, and a seating capacity of 400 persons. The addition includes enlarged kitchen and storage space, baker's room and small dining room.

Office Building.—A one-story building 32 by 48 feet of shingle construction on a cement foundation, with the interior finish of redwood, has been completed at approximately $2600. It contains the office of the Dean of the University Farm School and Vice Director of the Agricultural Experiment Station and the business office of the University Farm.

Minor Buildings.—Through an appropriation of $20,000 for repairs and small structures it has been possible to build the office building just mentioned above, and to repair and repaint all the buildings on the University Farm, work that was very much needed.

A number of separate buildings have been erected. A beef cattle barn 38 by 120 feet was constructed at a cost of $3321. The ground floor contains twenty-three box stalls and a store room, while the second story is for the storage of hay and other feed.

A laying house for poultry, 25 by 50 feet, one and one-half stories high, each floor divided into two rooms, has been built at a cost of $478; while an existing building 16 by 50 feet for the storing of poultry food had a second story added at a cost of $338.

A Farm Mechanics building 48 by 70 feet, one story high, of shingle construction and cement floor, has been built largely by the class in Farm Mechanics, at an approximate cost of $1565. The building is connected with the blacksmith and carpenter shops by a roof 16 by 30 feet, providing suitable covering for the traction engines and other tools. A one and one-half story building 30 by 44 feet of similar construction has been erected for the storage of tools, lumber, plumbing and other supplies, at an estimated cost of $1000.

A small structure 16 by 20 feet has been erected for the special work of the Division of Entomology, while a garage 12 by 16 feet has been built, both for a nominal sum.

A well has been dug for the purpose of irrigating the area devoted to vegetable gardening, to facilitate the investigations of plant pathology, at a cost of $420. It is 12 inches in diameter, 125 feet deep, cased with No. 14 galvanized pipe double. A layer of gravel was found extending from 98 to 120 feet, below which is a bed of clay.

Dairy Building Repairs.—During the year improvements have been made in the Dairy Building. The stairway was changed and several partitions taken out, thereby increasing the floor space in the creamery, cheese and ice cream rooms by some seven hundred square feet. This

additional space has aided materially in handling the large laboratory classes. Two new combined churns, a small power ice cream freezer, and three new cheese vats, besides other necessary equipment needed in the conducting of the commercial work, have been purchased during the year.

Feed lots at the University Farm showing cattle shed and silo erected during the year.

Betterments at the Imperial Valley Farm.—The deed to the last ten acres of the Imperial Valley Experiment Farm was secured by the payment of $1250 to I. W. Gleason by the Supervisors of Imperial County. This completed the purchase of the forty acres.

Several permanent improvements have been made on the farm in the last year which add greatly to the efficiency of the work done and add to the attractiveness of the place. A permanent concrete ditch 14 inches across the bottom and 15 inches across the top has been put across the front end of the farm. A concrete measuring weir with an automatic water register was installed to insure accurate measurements of water used in the various projects. A water-tight gate was put in to replace the old wooden gate. The construction of this ditch has not only made the water measurements more accurate, but has saved enough space to allow the planting of another row of trees across the forty, and will minimize the labor necessary in keeping the ditch clean of weeds and silt.

All of the ditches on the place have been reconstructed. Instead of the large "Fresno" made ditches, narrower ditches were made by

hand and much space saved. The time saved in keeping weeds out will soon pay for the improvements.

All of the lands of the farm have been re-leveled and re-bordered and are now in good shape. The fence along the east line was continued across the north line, thus completing the fencing of the forty.

The large ditch bank running the entire length of the farm has been leveled down and a road constructed on top of it. This has saved the space necessary for a road and has made an otherwise objectionable bank a utility.

Much pains has been taken in keeping the place in a neat and attractive shape.

CO-OPERATION

Most of the co-operative agreements described in some detail in the last annual report have been continued. Irrigation investigations which were started in 1907 have continued as heretofore under the general supervision of Mr. Frank Adams, Irrigation Manager of the Office of Experiment Stations, with Mr. S. H. Beckett in immediate charge, as reported on page 124. Drainage investigations have been under way in co-operation with the same office with Mr. W. W. Weir in immediate charge. He is employed jointly by the co-operating institutions and reports to the Director through Professor Charles F. Shaw of the Division of Soil Technology.

The Bureau of Soils of the United States Department of Agriculture has co-operated with the California Agricultural Experiment Station both in reconnaissance and detailed soil survey work. A co-operative arrangement has been entered into whereby the United States Geological Survey has prepared topographic maps in advance of the soil survey of the Santa Rosa 15′ quadrangle, latitude 38° 15′ to 38° 30′, longitude 122° 30′ to 122° 45′. The Department of Agriculture of the University contributed one-half of the expense of the survey estimated not to exceed $5000.

The co-operative branch seed laboratory of the United States Department of Agriculture, established on October 5, 1912, with Miss Anna M. Lute in charge, reporting to Professor John W. Gilmore of the Division of Agronomy, has made the following determinations:

	1912-13 No. of samples	1913-14 No. of samples
Purity	540	855
Germination	825	1265
Identification	234	288

The Division of Agricultural Extension in co-operation with the Division of Farm Management, Bureau of Plant Industry, United States Department of Agriculture, through the State Leader, Professor B. H. Crocheron, has organized the farm adviser or county agent system with its farm bureaus, and assisted the students of the College of Agriculture in organizing boys' and girls' clubs in the high schools of the state.

The arrangement by which the expert work of the Alameda County and San Francisco Medical Milk Commission was conducted by the Division of Veterinary Science, with Dr. C. L. Roadhouse in charge has proven eminently satisfactory.

The department through the divisions of Soil Technology and Veterinary Science has co-operated with the Selby Smelter Wastes Commission in conducting studies on the effects of smelter wastes on soils and crops.

There are twenty acres of forest trees of many varieties over twenty years old at the Chico Forestry tract.

PERSONNEL

It is not possible within the limits of this report to refer to the personnel of the department or to give adequate expression to the work of the twenty-two divisions of instruction and investigation. The Division of Forestry has been created and instruction was begun in this subject in the second half-year, with Assistant Professor M. B. Pratt in charge. The head of the Division of Forestry, Walter Mulford, at present the head of the Department of Forestry of Cornell University, will take charge on August 1, 1914. The work of this division is being fostered by the kindly attitude of the lumber men of the state and by the enthusiasm of the students of the Forestry Club

of the University. The subjects of study in forestry have already been announced.

The following list gives the Regents' appointments in the Department of Agriculture, who have begun their service within the fiscal year:

RICHARD LABAN ADAMS, Assistant Professor of Agronomy.
JAMES ALEXANDER ARMSTRONG, Field Assistant in Agricultural Extension, San Diego County.
JAMES T. BARRETT, Plant Pathologist in the Citrus Experiment Station and Professor of Plant Pathology in the Graduate School of Tropical Agriculture.
HARRY PERCY BARROWS, Instructor in Agricultural Education.
HAROLD E. BILLINGS, Laboratory Assistant in the Division of Agricultural Chemistry.
VIRGIL CLAY BRYANT, Assistant in Agricultural Extension.
ROY E. CAMPBELL, Assistant in Entomology.
DANIEL H. CAREY, Superintendent of Greenhouses and Gardens.
ANDREW HANSEN CHRISTIANSEN, Agricultural Adviser, Eureka, Humboldt County.
LILLIAN D. CLARK, Assistant in Agricultural Extension.
ROY ELWOOD CLAUSEN, Instructor in Genetics.
IRA J. CONDIT, Instructor in Citriculture.
B. H. CROCHERON, Assistant Professor of Agricultural Extension.
VALENTE FRANCIS DOLCINI, Assistant in Animal Husbandry.
H. H. DOUGLASS, Instructor in Dairy Husbandry.
HOWARD SAMUEL FAWCETT, Associate Professor of Plant Pathology in the Citrus Experiment Station and Graduate School of Tropical Agriculture.
HOWARD BRETT FROST, Assistant in the Citrus Experiment Station and Instructor in the Graduate School of Tropical Agriculture.
JOHN WASHINGTON GILMORE, Professor of Agronomy.
JOHN EDWARD GUERNSEY, Assistant in Soil Technology.
GEORGE H. HECKE, Farm Adviser, Yolo County.
ARTHUR HOWARD HENDRICKSON, Assistant in Pomology.
GEORGE W. HENDRY, Assistant in Agronomy.
D. R. HOAGLAND, Assistant Professor of Agricultural Chemistry.
O. W. ISRAELSEN, Assistant in Irrigation in co-operation with the Office of Experiment Stations.
TRACY R. KELLEY, Assistant in English and History in the University Farm School.
PATRICK BEVERIDGE KENNEDY, Assistant Professor of Agronomy.
OLLY J. KERN, Assistant Professor of Agricultural Education.
WYLIE EVERETT LLOYD, Assistant in Poultry Husbandry.
FRANK FARRINGTON LYONS, Assistant in Agricultural Extension, San Joaquin County.
WILLIAM C. MATTHEWS, Instructor in Scientific Illustration.
LAWRENCE KNOX MARSHALL, Assistant in Agronomy.
CARL SPENCER MILLIKEN, Assistant Superintendent of Agricultural Extension.
DAVID N. MORGAN, Assistant to the Director.
WALTER MULFORD, Professor of Forestry.

J. W. NELSON, Assistant Professor of Soil Technology.
LESLIE J. NICKELS, Instructor in Insect Industries, Davis.
W. F. OGLESBY, Assistant in Viticulture.
FRANK L. PETERSON, Assistant Professor of Farm Mechanics.
BURR B. PRATT, Assistant Professor of Pomology.
MERRITT BERRY PRATT, Assistant Professor of Forestry.
NILES POND SEARLS, Assistant in Agricultural Extension, Yolo County.
LESLIE T. SHARP, Assistant Professor of Soil Chemistry and Bacteriology.
ALFRED SMITH, Instructor in Soil Technology.
RALPH T. STEVENS, Assistant Professor of Landscape Gardening.
GUY R. STEWART, Assistant Professor of Agricultural Chemistry.
THOMAS TAVERNETTI, Assistant to the Dean of the University Farm School.
WALTER JENNINGS TAYLOR, Assistant Professor of Veterinary Science.
GORDON H. TRUE, Professor of Animal Husbandry.
E. C. VOORHIES, Assistant in Animal Husbandry.
WALTER WALLACE WEIR, Drainage Expert in the Division of Soil Technology.
FRITZ W. A. WOLL, Professor of Animal Nutrition.
CLEO JACK ZINN, Assistant in Soil Technology.

It is proper to state that a few of the individuals named have served the University in some other connection prior to their appointment by the Regents.

The following changes in title have been made for the ensuing year:

W. T. HORNE, from Assistant Professor to Associate Professor of Plant Pathology.

Miss E. H. SMITH, from Plant Pathologist to Instructor in Plant Pathology.

S. S. ROGERS, from Instructor in Plant Pathology to Assistant Professor of Plant Pathology.

P. S. BURGESS, from Instructor in Soil Bacteriology to Assistant Professor of Soil Chemistry and Soil Bacteriology.

H. J. QUAYLE, from Assistant Professor to Associate Professor of Entomology.

C. L. ROADHOUSE, from Assistant Professor of Veterinary Science to Associate Professor of Veterinary Science.

J. F. MITCHELL, from Instructor to Assistant Professor of Veterinary Science.

W. M. MERTZ, from Assistant in Pomology to Superintendent of Cultivations.

E. J. LEA, from Assistant Professor to Associate Professor of Nutrition.

S. H. BECKETT, from Instructor in Irrigation to Assistant Professor of Irrigation Practice.

In a department so complex and withal so new, with twenty-two divisions and fifty odd new appointees, there are necessarily many points of contact. Between divisions there is often a shadow land which is not yet well defined and may never become so. It is a source of gratification therefore that in the enthusiasm for their work these several divisions and individuals find it possible to exercise that elasticity which makes possible an effective whole. If there is one thing

more than another by which the staff is characterized, it is a willingness to serve unstintingly the public for which the department was created.

The Director has summarized the reports of the several branches and divisions of the Department of Agriculture in the following pages.

Very respectfully submitted,

THOMAS F. HUNT.

At the University Farm. The Office Building on the right was built during the present fiscal year.

REPORTS OF DIVISIONS

THE UNIVERSITY FARM

BY
H. E. VAN NORMAN

University Farm School.—No striking change has been made in the course of study as outlined at the beginning of the present school year, except that systematic work in Vegetable Gardening has been added under the supervision of Mr. S. S. Rogers, and Entomology under Mr. L. J. Nickels, and the work in the shops, forge and farm machinery has been grouped together as a division of "Farm Mechanics" on a par with the division of Animal Husbandry, Dairy Industry, etc.

The raising of the entrance age in the fall of 1912 and the emphasis put upon the courses as designed for older men who have not high school graduation as a preparation for further education, brought an increased number of this class of men, as will be seen from the figures following. An unexpected influx of high school graduates offering credits equivalent to our first year's work threw an unforseen teaching burden into the second-year subjects, rather than the first year, as anticipated.

Attendance.—The total number of new students entering at the beginning of the first semester was 122, of whom fourteen had no high school training; fifty-nine were graduates of high schools, and forty-nine had one or more years of high school work. Nine students entered with credits from other institutions of college grade.

The short courses brought 134, and during the second semester, sixty-one University students were enrolled, of which number three were young ladies.

Twenty-two new students enrolled in the three-year course at the opening of the second semester, of whom thirteen were high school graduates, eight had one or more years of high school work, and one had less than one year. Seven students entered with credits from other institutions of college grade.

The student enrolment for the year included four students from the Philippine Islands, two from Chile, one from India, one from Germany, one from Australia, one from China, one from Mexico, and from the states, New Jersey, 1; Illinois, 1; Utah, 1; Nevada, 2; the balance from our own state.

The following students were given a certificate on May 22, 1914, upon successfully completing the three years' course in Agriculture at the University Farm School:

Dolph Chadwick Allen
Lucius Ray Bates
Ralph Edgar Beam
John Jeremiah Bogardus
Clifford Edgar Bresee
Hugh Dyer Cameron
Theodore John Cameron
Leo Rowland Canman
Harold Gustavus Claudius
Irl Daniel Dickson
Chun Johnston Hargitt
William Dean Haupt
Karl Herman Hummel
Marion Raymond Laird
Stephen George Langford
Bernard Alexander Lucke
Winfred Harold Moebus
John Spafford Rowell
Alvin Charles Schammel
Allan Hartwell Showler
Bruce Marcus Stern
George Dorian Walton
George Charles Watson
Walter Dresser Whitman
George Richard Wilson
Carol Willard Wright

SUMMARY OF ENROLMENT FOR THE YEAR

		Total
Farm School students:		
1st semester, new	122	
1st semester, re-entered	66	
2nd semester, new	22	
		210
Short Course students:		
General Agriculture	47	
Animal Husbandry and Veterinary Science	27	
Dairy Farming	16	
Dairy Manufactures	22	
Horticulture and Viticulture	45	
Poultry Husbandry	11	
Visitors, all classes	2	
	170	
Deduct for registration in more than one course	36	
		134
University students, second semester		61
Total enrolment		405

During the year six students have been dropped for inefficient work, and thirty-seven have dropped out without completing the semester's work begun, due to various causes of a personal nature.

INSTRUCTION

In addition to the instruction mentioned elsewhere, the following has been given:

Botany.—Mr. C. J. Wight of the Botany Division has had a student assistant during the second semester, Mr. H. K. Dickson, who desired to secure necessary practice for teacher's certificate. He has conducted one laboratory section and delivered six lectures in Plant Breeding, to each of two sections of the class. Eighty-five students have been registered during the fall semester, and seventy-five for the spring semester. A collection of 160 specimens of native plants of Nevada County was made during the summer vacation, also several native forage and poisonous plants, and seeds of bur clover have been collected.

Chemistry.—The peculiar variety of preparation possessed by students makes this a difficult course to teach. A beginning has been made, however, and a suitable laboratory guide and manual for this class of students is being worked up. Sixty-six students were registered during the fall semester, and eighty-six the second semester.

English.—Sixty-two students were registered during the fall semester, and forty-two during the spring semester. Mr. Kelley has also acted as Secretary of the Faculty, and Chairman of the "Committee on Scholarship."

Hygiene.—Emphasis has been placed on personal hygiene, sanitation and first aid to the injured, to all first-year students, who numbered 144 for the year.

Irrigation.—Instruction has been given to thirty-six Farm School students, and twenty-four University students, in addition to the investigational work reported elsewhere.

Mathematics.—Instruction has been given to eighty students in mathematics, and forty in surveying.

Soils.—Instruction has been given to ninety-seven students the first semester compared with forty-three the preceding year. In addition to this work, Mr. Koeber has taught a class in Farm Mechanics.

Vegetable Gardening.—Instruction in this subject has been given to nineteen regular and two special students the second semester. A beginning has been made in the accumulation of the necessary equipment and tools for instructional work.

Special Lectures.—Wednesday of each week at eleven o'clock has

been set aside for a general assembly. Some days the hour has been devoted to matters of interest to the Associated Student Body. These meetings have been addressed by the following prominent men:

S. P. Frisselle, Manager Kearney Ranch ..... Fresno
G. H. Hecke, County Horticultural Commissioner (Yolo) ..... Woodland
W. G. Stimmel, Manager Vina Ranch ..... Vina
Miss Stella Huntington, County Librarian (Yolo) ..... Woodland
Albert M. Paul, with Natomas Consolidated of California ..... Sacramento
A. J. Cooke, Horticultural Commissioner ..... Sacramento
Geo. P. Weldon, Deputy Horticultural Commissioner ..... Sacramento
Thos. R. Murphy, Fire Chief of San Francisco ..... San Francisco
Harris Weinstock, California Industrial Commissioner ..... San Francisco

Sunday evening at 6:10 there has been held a sunset meeting in the living room of the dormitory during the winter, and on the lawn when the weather permitted. Messrs. Albert Rinn (a University student and member of the University Glee Club) taking work at the University Farm during the second semester, and Walter Whitman, of the senior class at the Farm School, have had charge of the music, which has added much to the interest in these meetings. The following speakers have addressed the meetings:

Prof. T. H. Reed, Political Science Department, University of California ..... Berkeley
Prof. J. W. Gilmore, Agronomy Division, University of California ..... Berkeley
Judge C. E. McLaughlin ..... Sacramento
Prof. H. E. Cory, English Department, University of California ..... Berkeley
Charles G. Titus, Secretary Y. M. C. A. ..... Sacramento
J. E. Stubbs, President, University of Nevada ..... Reno, Nevada
A. C. Jenvy, Graduate Princeton University (visitor) ..... Davis
Edward Hyatt, State Superintendent Public Instruction ..... Sacramento
Mr. Edward Berwick, Universal Peace Propagander ..... Monterey
Max Thelen, Railroad Commissioner ..... San Francisco
Benj. Ide Wheeler, President University of California ..... Berkeley
Clare M. Torrey, Secretary to President University of California ..... Berkeley
Mrs. W. Longbotham, Chairman Music Committee, State Federation Women's Clubs (Northern District) ..... Sacramento
Forrest Plant, Soloist ..... Davis

Student Activities.—Discipline in the dormitories has been wholly in the hands of the Student Association, and instructors who formerly received perquisites in the way of room rent for the supervision of student discipline have been relieved of that responsibility

and pay their regular room rent. The Student Conference Committee, conferring with the Dean on matters of importance, was appointed earlier in the year. This has been succeeded by a Welfare Committee, as an integral part of the Associated Students' organization.

During the second semester an Agricultural Club was organized, numbering some sixty members, and including both University and Farm School students in its membership. A splendid harmony has prevailed this second semester between the University students and Farm School students resident on the campus; a marked improvement over that of a year ago.

University Farm Administration.—With the beginning of the fiscal year, the re-organization incident to the abolition of the Superintendent of the Farm, Principal of the School, and Business Manager, and the grouping of these responsibilities under the direction of the Vice-Director and Dean, with an assistant, and the administration of school matters through committees reporting to the Faculty, became fully effective.

Several divisions have been represented by resident members of the staff of the College of Agriculture, resulting in increased activities in those lines of work. The development of a vegetable garden, which should supply certain fresh vegetables to the Dining Hall and others who may desire them, with the resulting opportunity for actual practice in vegetable growing by the students, and the acquiring of first hand information for the answering of correspondence, is a feature of the year's development.

Farm.—Practically all the crops produced on the farm have been fed on the farm. In addition to the regular routine work of the Farm Division, a large amount of hauling of gravel for drives and of lumber for the construction-work has been done by its teams and laborers.

In addition to the products of the Farm consumed on the Farm, the sales from July 1, 1913, to June 30, 1914, have been as follows:

Poultry	$2,665.29
Agronomy	611.97
Animal Husbandry	17,337.12
Viticulture	273.18
Dairy	55,191.48*
Total	$76,079.04

Grounds.—The supervision of the grounds has been placed in the hands of Mr. F. Flossfeder of the Viticulture Division, who has had much experience in the growing and handling of ornamental plants.

* See page 108.

The unusual amount of rainfall, making for favorable planting of ornamental material, has prompted the setting out of a large number of ornamental trees and shrubs. The selection of varieties has been made by Professor J. W. Gregg of the Division of Landscape Gardening at Berkeley, according to a systematic plan. The maintenance of this material will involve a constant expense for water and cultivation until the trees get large, when little will be required.

Class in hygiene being given a first-aid lesson in resuscitation at the University Farm, Davis.

Infirmary.—A total of 173 cases have been handled in the Farm School Infirmary, which were: Abscesses 4, boils 18, sprains 12, felon 1, tuberculosis 1, carbolic poison 1, influenza 7, coryza 18, headaches 16, acne 7, ringworms 5, varicocele operation 1, catarrh (nasal) 3, tonsilitis (acute) 7, infected wounds 20, punctured wounds 15, fractures lower leg 2, plaster casts 3, fractured toes 2, fractured fingers 3, finger amputation 1, ingrowing toe nails 2, warts and corns 6, periostitis bone of foot 1, acute bronchitis 8, antityphoid vaccination 2, acute pharyngitis 2, chilblains 2, pneumonia 3.

In addition to the usual run of minor ills, the infirmary was called on to care for one case of pneumonia involving the employment of an extra night nurse.

For the first time, every student was required to submit to a physical examination at the opening of the school year. Fortunately, it was not necessary to reject any as physically unfit. Examination of the eyes and ears showed an unusual freedom from serious defect. Examination of the eyes by Dr. Milton H. Schutz showed 99 of 159 students suffering from errors of refraction. About two-thirds of

First aid to the injured is a part of the curriculum.

these have been properly corrected; the remainder were advised to give their eyes the necessary attention to correct this condition. Seventy-eight had more or less nasal defects, some of which are undoubtedly affecting their ability to study.

Library.—The library has received 163 new books by purchase, and 65 by gifts, 27 of which were donated by a student, Mr. C. A. Halsey. The total number of books in the library is 2,169, of which 560 are herd books, shelved at the Animal Husbandry Division. Some 950 bulletins have been received during the year. Eighty-seven periodicals are received regularly, 38 of which are gifts.

The library is a distributing station for the Yolo County Free Library. About 100 books of fiction have been handled through this co-operative arrangement between the County and State library. Any books in the State Library have been available upon request through this arrangement.

Gifts.—The University Farm has received the following gifts during the past year in addition to those enumerated in the reports of Animal Husbandry, Dairy Industry, Farm Mechanics and Poultry Husbandry, and in addition to numerous loans.

CASH CONTRIBUTIONS

Ministers (attending "Ministers' Week," December, 1913)	$339.75	
Marin County Teachers' Institute, account lecture by H. E. Van Norman at their meeting April 7–14	25.00	
British Columbia Live Stock Association, Honorarium account lecture by H. E. Van Norman	10.00	
		$374.75

EQUIPMENT

Curley redwood for making office table.
By Promotion & Development Committee, Humboldt Chamber of Commerce, Eureka, Calif.

1 Redwood stave silo.
By the Redwood Manufacturers Company, San Francisco.

Sample grains South American corn, 1 inch long by ¾ inch wide.
By D. O. Lively, Department Live Stock, Panama Pacific Exposition, San Francisco.

CITRUS EXPERIMENT STATION

BY

H. J. WEBBER

In the Citrus Experiment Station the year has in large measure been one of reorganization. The new plans for the enlargement of the Station necessitated the employment of new men, purchase of equipment and development of plans for the extension of the investigations. This work of reorganization is still in progress and cannot be completed until the new Experiment Station farm and buildings are ready for occupation. It has been necessary to maintain the work started at the old Citrus Experiment Station at Riverside, which has served as temporary headquarters for the Station and at the Pathological Laboratory in Whittier, a part of the force being maintained in each place. The maintenance of the force in separate places and the impossibility of developing the laboratories and library in permanent place has been a great interruption to the proper development of the work. Fortunately this condition will soon be remedied as rapid progress is now being made in the preparation of the new site. Material progress has been made, nevertheless, in the organization of the staff of workers, and in the investigations, so that the year has been a valuable and active one.

A Study of the Fertilizer Requirement of Citrus Fruits.—This experiment, first outlined by Prof. Ralph E. Smith, was started on new land, the young trees being selected and planted particularly for the purpose. Twenty different plats were included, each of which was given a different treatment. Each plat contains 24 trees, 6 naval oranges, 6 valencia oranges, 6 Eureka lemons and 6 Lisbon lemons. Each plat is separated on every side from every other plat by guard rows of trees not included in the experiment, other than to prevent the influence of one plat extending over to another. The irrigation of each plat is separate, no water from one plat crossing onto another.

The trees were planted in April 1907 and are thus seven years old. They began bearing in 1910 and there has thus been four crops, but the freezes of 1913 and the preceding winter caused considerable damage, particularly to the lemons. The Lisbon lemon is a late bearer and this character, coupled with frost injury, has prevented a crop

production on these trees of a size sufficient to give any results of interest.

The following table gives the treatment of each plat and the average yield per tree for four years in number of fruits per tree:

AVERAGE YIELD PER TREE FOR FOUR YEARS IN NUMBER OF FRUITS

	Plat A Complete Fertilizer	*Plat B* Nothing	*Plat C* Blood	*Plat D* Sulfate of Potash	*Plat E* Bone
Navel	84	27.66	96.5	29.33	152
Valencia	53.16	3.16	169	12.5	155.25
Eureka	161.83	115	184	78.16	139

	Plat F Manure	*Plat G* Nitrate Soda, Blood, Bone	*Plat H* Nitrate Soda	*Plat I* Muriate of Potash	*Plat J* Super-phosphate
Navel	54.66	61.83	169.83	24.2	43.5
Valencia	68.83	64.83	111	33.33	76
Eureka	65.33	80.33	126.16	130.33	107

	Plat K Bone and Potash	*Plat L* Nitrate Soda, Blood, Potash	*Plat M* Nothing	*Plat N* Acid Phosphate	*Plat O* Manure and Slag
Navel	54.5	68.16	92	86.5	69.25
Valencia	59.66	73.6	46	50.66	72
Eureka	119.33	169.5	75	93	172

	Plat P Super-phosphate and Bone	*Plat Q* Complete	*Plat R* Sulfate of Potash	*Plat S* Blood	*Plat T* Nothing
Navel	61	103.33	59.66	193.66	119.33
Valencia	95.83	137.83	93.83	110.83	71.33
Eureka	88.66	164.16	59.33	93.16	43.75

A few important suggestions can now be deduced from the results, but the experiment must run for a much longer period before the final results will be visible. The trees are still young and the early yields are naturally low.

The most noticeable factor is the high yields of the nitrogen plats, in particular plats C and S, treated with dried blood, and plat H, treated with nitrate of soda. The low yield of the untreated plats labeled "Nothing" is also worthy of note, considering the indifferent effects sometimes obtained in the use of fertilizers. Plate A and Q, treated with what is ordinarily designated as a complete fertilizer,—that is, one containing what is supposed to be the nearly correct amount of potash, phosphoric acid and nitrogen—are in excellent condition

and gave good comparative yields. The manure plats are rather disappointing in yield, but the trees are in excellent condition. In general the potash plats are poor in yield and the trees show little growth, being slightly if any better than the untreated plats.

One of the most interesting features of this experiment is the different degree or amount of mottle leaf shown by the different plats. Mottle leaf, which is probably a symptom of many diseases, is apparently the first sign of weakness or disease in the tree.

The nitrate of soda plat (H), which has given a very high yield up to the present time, is now very badly mottled, about eighty per cent of the leaves being discolored. This plat is clearly the worst mottled plat in the grove. It seems to be true that every plat receiving any nitrate of soda is badly mottled, as for instance, Plat A, 50 per cent, G, 50 per cent, H, 80 per cent, L, 60 per cent. Plat Q, however, which had nitrate of soda in a complete manure along with blood, superphosphate and sulfate of potash, was graded as having only 5 per cent mottling. Nitrogen from organic sources does not seem to have the same effect, as the blood and manure plats show much less mottling.

The best plats in the experiments, all points considered, seem to be those treated with dried blood, as they have not only given high yields but appear very healthy.

The present results from the experiments would therefore indicate the importance of nitrogen fertilization, and the desirability of using nitrogen from organic sources rather than from such chemicals as nitrate of soda. They would also suggest that the soil at the Experiment Station requires a minimum amount of potash. The results would leave us in doubt regarding the importance of phosphoric acid but suggest a medium amount as desirable.

It must be clearly recognized that the results as yet give only suggestions. These experiments must be carried for a much longer period before the final results can be given. It is of the highest importance to get conclusions from a much larger and more complete series of plats and this, it is expected, will form one of the main lines of investigation in the future.

Green Manure Crops for Southern California with Special Reference to Their Use in Citrus Orchards.—An experiment to determine the value of the nitrogen added through the medium of leguminous green manure crops was inaugurated by Mr. J. H. Norton, during the fall of 1909. Since the latter's resignation, the work has been conducted by Mr. W. M. Mertz.

This experiment consists of nine legume plats and eight non-legume plats alternating with each other. All plats are treated uniformly during the winter months, while the green manure crops are growing.

In the early spring the tonage of green tops per plat is obtained. Following this, all of the crops are plowed under and various field crops sown.

As soon as these crops have started growth, four of the non-legume plats are treated with varying amounts of nitrate of soda. All other cultural operations are carried on uniformly over all plats. The yield of the field crops are accurately determined by weighing the products of each plat. The results thus obtained are taken as indicators of the value of the utilized nitrogen from the two sources; that is, nitrate of soda and legumes.

The following table gives the average yield for the first five years in green tops per acre:

*Purple vetch (Vicia attropurpurea)	18¼ tons
†Tangier peas	14 tons
Melilotus clover (Melilotus indica)	12¾ tons
Fenugreek	12⅓ tons
Common vetch (Vicia sativa)	12 tons
Lentils	12 tons
Bur clover	12 tons
Barley and rye (average)	12 tons
†Bitter vetch (Vicia ervilia)	11½ tons
Canadian field peas	9 tons

* Grown for one year only.

† Seed not yet available commercially.

From this table it is seen that the common vetch and Canadian field peas, which are most generally used, produce much less organic material per acre than several of the newer varieties tested. The purple vetch and melilotus clover are especially promising, the former giving the heaviest tonage of tops for the one season during which it was grown. It is so vigorous in growth that it entirely chokes out all weeds. Another feature of importance is its resistance to aphis attack, a characteristic not possessed by the other vetches.

The melilotus clover has given very satisfactory results during its four year test. It is found growing wild all over the southern part of California and is apparently adapted to a great variety of soil types. It is very deep rooted, resistant to aphis attack and also withstands quite low temperatures. In the table following, we also find that this clover has given striking increases in yield of the crops following its incorporation with the soil.

The following table gives the yields of corn, potatoes and sugar beets following the incorporation of the different green manures with the soil.

Soil Treatment	4-year average yield shelled corn in bushels per acre	2-year average yield potatoes in bushels per acre	2-year average yield sugar beets in tons per acre
Common vetch	35	171	15.3
Barley plus 810 lbs. nitrate of soda	34	191	16.0
Bur clover	35	228	17.3
Barley	29	152	13.4
Barley plus 270 lbs. nitrate of soda	32	166	12.5
Vetch, V. ervila	38	231	16.7
Barley	27	166	10.7
Canadian field peas	40	243	17.6
Barley plus 1080 lbs. nitrate of soda	41	218	17.7
Tangier peas	42	227	20.5
Barley	28	163	12.3
Melilotus clover	46	252	19.8
Barley plus 540 lbs. nitrate of soda	42	204	15.7
Fenugreek	43	255	16.8
Barley	35	164	12.7
Lentils	43	204	19.5
Average yield on legume plats	40	226	17.9
Average yield on barley plats	30	161	12.3
Average increase due to nitrogen added by legumes	10	65	5.6

From this table it is seen that very marked increases in yield have resulted from the additions of nitrogen to the soil. It is of interest to note the large quantities of nitrate of soda necessary to bring up the yields on the barley plats on a par with those growing legumes.

This is especially significant because of the fact that practically the same amount of organic material was plowed under in the case of the non-legume plats as on those growing legumes.

Thus the great differences in the yields is apparently due to the nitrogen added from the air through the symbiotic action of the nitrogen fixing bacteria with the roots of the legumes.

The Effect of Different Stocks on the Commercial Species and Varieties of Citrus.—A study of the varying effects of different stocks upon citrus trees was started at the Riverside Station in April, 1907, according to plans prepared by Professor R. E. Smith and assistants. The varieties consist of Washington navel and Valencia oranges and Eureka lemon, grown upon sweet, sour and trifoliate orange stock and upon pomelo. The experiment originally comprised 222 trees,

divided into two blocks on different locations on the station grounds. Block A comprised 55 trees, and block B, 167 trees.

In May, 1909, the Washington navels on pomelo in Block A were removed from their original position, and set as a continuation of the row of navels on sour stock. Such transplanting excluded these trees from the experiment.

Of the original number of trees in the experiment, a few have in the course of the work been killed by cold or disease. Treatment in respect to fertilization, cultivation, irrigation, and cover cropping has been uniform.

To date the trees in respect to size and vigor rank in descending order as follows:

Washington Navel Orange

Block A	Block B
1st. Sweet.	1st. Sweet.
2d. Trifoliate.	2d. Sour.
(Removal of sour stock trees previously noted.)	3d. Trifoliate.

Valencia Orange

Block A	Block B
1st. Pomelo.	1st. Trifoliate.
2d. Sweet.	2d. Sweet.
3d. Sour.	3d. Pomelo.
4th. Trifoliate.	4th. Sour.

Eureka Lemon

Block A	Block B
1st. Sweet.	1st. Sour } about equal.
2d. Sour } practically	2d. Sweet }
3d. Pomelo } equal.	3d. Pomelo.
4th. Trifoliate—markedly dwarfed.	4th. Trifoliate—markedly dwarfed.

The differences in the growth in the two blocks may be partially ascribed to soil differences.

Block A is on a somewhat lighter soil than B, which doubtless accounts for the improved showing of trees on trifoliate stock in the latter block. On the heavier soil trees on trifoliate roots hold their own in comparison with other stocks in the case of oranges. The striking fact brought out is the marked dwarfing of the lemon trees on trifoliate in every instance. Another noticeable fact is the increased diameter of the trifoliate stock below the bud union in practically all cases.

The following table is a summary of the crop data for the years 1910–1913 inclusive. The data for lemons is for 1910–1912 inclusive, no fruit resulting after the freeze of January, 1913.

			RESULTS, 1910–13				
			Average Yield in number of fruits per tree				
Variety	Stock	Number of trees in plot	1910	1911	1912	1913	Average Yield per tree, 1910–1913
Washington	Sweet	45*	.04	4.3	22.6	120	143.9
Navel	Sour	16*	0	6.2	40.7	162.6	172.6
Orange	Trifoliata	19	0	7.4	43.2	66.4	117.0
	Sweet	20	0	4.6	41.4	139.9	186.0
Valencia	Sour	16	0	5.6	44.8	130.3	180.7
Orange	Trifoliata	20	1.1	23.8	119.3	206.2	350.5
	Pomelo	17	0	3	36.6	143.1	182.8
	Sweet	15	1.1	2.1	110.7	No	113.9
Eureka	Sour	18	.8	5.8	126.5	fruit	133.2
Lemon	Trifoliata	20	6.8	17.3	73.4	in	97.5
	Pomelo	10.6*	4.2	16.1	159.3	1913	171.7

* Indicates average number of trees in plot where some have died in the course of the experiment.

In point of fruit production, the first year shows little or no yield, with a natural increase in each successive season. By 1913 the navel on sour has outstripped the crop on sweet in respect to yield, with trifoliata a poor third. Valencia orange on trifoliate shows a consistent and striking advance both in yield per tree and average yield for four years over the other three stocks.

In the case of Eureka lemon, pomelo holds first place with sour, sweet and trifoliata following in the order named.

A Study of the Varieties of Citrus Fruits and Their Relatives.—The commercial orchards of California are in large measure limited to plantings of Washington Navels and Valencia Oranges, Eureka and Lisbon Lemons, Marsh Seedless Grape Fruit and the Dancy Tangerine. These are doubtless the best varieties now available, but it is questionable if they represent the highest perfection obtainable. California produces more citrus fruits than any other region in the world and it is important that all known varieties should be introduced and tested in the state in comparison with the varieties now grown.

For several years different varieties have been accumulating at the station. Trees of 14 different varieties besides the ordinary sorts were planted in 1907. Trees of 53 other different sorts have been budded previous to January 1, 1914. During January and February of 1914 Prof. H. S. Fawcett of the station visited Florida, Cuba, and

the Isle of Pines and arranged for the importation of a large number of interesting varieties and forms. This collection included 64 standard named varieties and about 76 different minor varieties and selected interesting forms. From 5 to 10 trees have been budded with each variety where bud wood was obtained, and where seed was imported seedlings are being grown.

Bud wood of a considerable number of varieties, collected in Brazil by Mr. A. D. Shamel of the United States Department of Agriculture, was also used at the station in April in propagating trees for testing the varieties. These tests will be carried out in co-operation with the United States Department of Agriculture.

It is hoped that the collection of varieties now well started may be made the most complete collection of citrus varieties in the world and furnish the material for a careful systematic study of this group of fruits.

A Comparative Efficiency Test of Orchard Heating Devices.—The importance of artificially heating groves to protect them in the case of severe freezes is considered to have been demonstrated by numerous experiences during the freeze of January, 1913, and as a result growers are greatly interested in orchard heaters. Numerous types of heaters have been devised and put on the market and no data or experience is available from which to judge the efficiency of the different types. In order to get some basis of judgment, Professor W. W. Bonns, in co-operation with Dr. L. J. Briggs and Mr. J. W. McLane of the United States Department of Agriculture, has conducted a series of experiments to determine the heat radiation from pots of different types. Their experiments are still in progress, but will ultimately give data indicating the type of heater giving the most efficient radiation per unit of oil consumed.

A Study of the Comparative Infectiousness of the Crown Gall Organism (Bacterium tumefaciens), with Special Reference to Finding Resistant Forms of Prunus Suitable as a Rootstock for the Various Stone Fruits.—Studies, by Mr. C. O. Smith, are now under way continuing the work already published in California Station Bulletin No. 235. From data now obtained, stone fruit stocks have been found, showing much more resistance to crown gall than those now being used. The adaptability of these to general nursery purposes has not yet been sufficiently determined. Experiments are being continued in both of the above investigations. The resistance of these stocks is being determined by growing seedlings in naturally infected soil, and by artificial inoculations with pure cultures of the crown gall organism, *Bacterium tumefaciens.* Experiments in tree surgery seem hope-

ful where used on small trees not too severely infected. Special use of germicides on roots of nursery trees before planting in orchard is being tested. It is hoped that some practical control may be secured from this latter treatment.

A Study of Lemon Decay Fungi, with Special Reference to Their Control by Wash Water Disinfection.—This particular disease causes serious decay in lemon packing houses, and special attention is being given to finding more effective methods in the use of germicides to be used with the wash water in its control. The spores during the winter months are produced in the orchard and brought into the packing house in the fruit. The decay develops in three or four weeks during the curing or storage of the fruit.

The experiments now under way are very promising, but not sufficiently complete to be reported upon at this time.

The same fungus is becoming of importance in the orchards, as under certain favorable climatic conditions it is capable of infecting the fruiting and other twigs. Occasionally small citrus trees wrapped with corn stalks have been attacked as well as orange seed bed stock.

A Study of Black Pit of Lemons.—This blemish, which has been studied by Mr. C. O. Smith, is probably the first bacterial disease of citrus fruits to be described. It appears to a limited extent in the lemon orchards of Southern California during the winter and spring months, and is caused by a new species of bacterium, *Bacterium citriputeale.* This organism has been studied and its life history worked out. The disease has been artificially produced on lemons, Navel and Valencia oranges, grape-fruit and limes.

The spots or pits are found entirely in the rind, are circular or oval in outline ¼ to ½ inch in diameter, firm (not a soft rot), reddish brown to black in color. The diseased tissue is depressed somewhat below the normal oil glands into the white substance of the rind. In the center of the pits can often be found an injury, like a thorn stab, where the infection has taken place. The disease at present is well distributed throughout the lemon growing sections of California, but is not sufficiently abundant to demand special control measures.

Investigations as to the Causes, Manner of Development, and Treatment of Gum Diseases of Citrus and Other Fruit Trees.—A further investigation has been made by Prof. H. S. Fawcett of the causes and best methods of control of gum diseases of citrus trees. The disease known as Gummosis is characterized by dying of large areas of bark on the trunk accompanied by the exudation of gum. The importance of these diseases is indicated by a statement from a prominent lemon grower to the effect that he had taken out one per

cent per year of large bearing trees from gummosis alone. This did not take into consideration the injury to trees that were weakened by the disease, but not sufficiently injured to be taken out. By a series of inoculation experiments extending over more than two years, it has been conclusively shown that the causal agent in at least two forms of Gummosis are fungi, the brown rot fungus (*Pythiacystis citrophthora*), and the grey fungus (*Botrytis vulgaris*), both well known as causing rots of fruit in the citrus packing houses.

As the result of a large number of experiments in the prevention and cure of Gummosis carried out in co-operation with a number of citrus growers, it has been shown that in addition to the previously well known methods of prevention these forms of Gummosis may be successfully prevented by painting the trunks with a concentrated Bordeaux wash known as Bordeaux paste, and trees already affected may be cured if taken in time by cutting out diseased bark and painting the wounds and entire trunk with Bordeaux paste.

Certain other fungi were also shown to be capable of inducing gumming in citrus trees. Wounds of all kinds made on the healthy bark of citrus trees were found to heal without gumming, unless contaminated with organisms or subjected to chemical stimuli.

A large part of this work was done by Prof. H. S. Fawcett while employed by the State Commission of Horticulture, from February 1, 1912, to September 1, 1913. The work has been continued and the investigations extended since that time. The Brown Rot Gummosis has also been definitely shown to be present in Florida, Cuba and the Isle of Pines.

Investigations as to the Cause and Treatment of Melazuma of English Walnut Trees.—Investigations as to the cause and treatment of a new disease of English walnuts in Santa Barbara County, which has been called Melaxuma, were begun by Prof. Fawcett in June, 1913, at the request of Mr. C. W. Beers, County Horticultural Commissioner. The disease is characterized by large, black cankers on the larger limbs and trunk and by the girdling and wilting of smaller branches. Mr. W. H. Nixon and Mr. C. A. Hollister had previously proved that the disease was infectious by transmitting it from diseased cankers to healthy limbs by means of ax or chisel cuts and by the insertion into healthy bark of pieces of diseased material. Further inoculation experiments with material from diseased cankers confirmed this work. Cultures of a fungus were obtained from these cankers, which on being inoculated into healthy limbs were shown to be capable of producing the disease. A few preliminary experiments in treatment indicate that the cankers may be checked in their spread

by cutting out and treating with a fungicide as Bordeaux or lime sulfur paste.

Routine Examination of Material Sent to the Citrus Experiment Station, and Minor Studies in Mycology and Bacteriology.—Outside the special field of citrus and walnut diseases there frequently arise troubles more or less seriously affecting other agricultural crops. These will receive consideration as they arise. While no project, aside from one on Crown Gall, has been outlined for any one special disease of this class, provision is made to include such studies under a general project covering observations and studies on minor troubles. If, at any time, some one or more of these so-called minor maladies becomes of sufficient economic importance, the same may be given special attention and a new project formulated.

Some Studies on Mottling of Citrus Trees.—In taking up the careful study of such a general disease as mottling, it must be recognized that there are open to the investigator several points of attack. Different single or grouped factors may be concerned in different localities. Therefore there appears to be no best line of attack which stands out prominently above all others. It is therefore not easy and possibly not desirable to formulate all studies pertaining to mottle leaf under one project.

Aside from the study on the relation of the citrus nematode to mottle leaf and the various fertilizer, soil, and stock experiments which have a bearing on the same, a project has been planned with a view to obtaining more information concerning the effects of the disease on the host, and the relation of certain factors to its occurrence.

It is proposed to determine the relation of starch formation and translocation to mottle leaf; to compare the histology of diseased with that of normal leaves; to make a comparative study of the roots of the diseased and healthy trees; to determine the relation of iron to mottling; and to ascertain whether mottle leaf is an infectious type of chlorosis.

A Study of Fruit Spots and Stains.—Fruit blemishes, particularly certain well defined spots and stains, have been so prevalent during this season that they have demanded special attention. These troubles have caused in some localities considerable loss on account of dropping, decay and lowering of grades of fruit.

Studies thus far carried on by Dr. Barrett have not revealed the cause of either the brown or green spots, two of the most prevalent spot troubles. Their general characteristics indicate that they are not due to parasitic organisms. A third trouble, which presents the appearance of a dull reddish green stain on oranges, lemons and

pomelos, has been usually prevalent in certain localities. This disease is now believed to be caused by a fungus of the Gleosporium type. Experiments to definitely determine this point are now under way.

A Study of the Horticultural Condition in Florida, Cuba and Isle of Pines, with Special Reference to Citrus Culture.—In a trip to Florida and Cuba during the winter, in addition to the importation of bud wood of citrus varieties, Professor Fawcett made a study of citrus conditions with special reference to diseases. It was definitely shown for the first time by isolating pure cultures of *Pythiacystis citrophthora* from diseased gumming trees that the Brown Rot form of Gummosis was present in the above countries. The same fungus was also found associated with a case of so-called footrot or Mal-di-gomma in Florida. Important data in regard to the similarity or difference of other diseases to those occurring in California were gathered. Interesting data were also obtained in regard to the methods of treatment of citrus groves on various soils to obtain good results in these countries. One of the most striking observations was the beneficial effects of covering the entire soil with a deep straw mulch on certain soils in Cuba. While it may be impossible to apply these methods without modification to California conditions, they serve as valuable suggestions for future experimentation. A series of photographs illustrating different phases of citrus culture in these countries was also made.

The Nematode Problem on Citrus Trees.—A preliminary report by Mr. E. E. Thomas of a nematode found attacking roots of citrus trees was issued in February, 1913 (Circular No. 85). Since that time extended observations have been made in various parts of the state to determine the extent of spread of the pest. It has been found in practically every section of the state where citrus trees are grown. Many groves and nurseries, however, still apparently remain free from infection.

Careful studies are now being made to determine the effect of the nematodes on the trees. In one experiment 20 trees, each of five different varieties, Eureka and Lisbon lemons, Washington Navel and Valencia oranges and Marsh Seedless pomelo, all budded on sour stock, were planted in large pots in steam sterilized soil. Half of these pots were later inoculated with nematodes in order to compare infected and non-infected trees.

To test the relative effect on the three most generally used stock, 200 seedlings each of sour orange, sweet orange and grape fruit are being grown in small pots of steam sterilized soil. In each case 100 seedlings have been inoculated with the nematode. To further test

the relative susceptibility of different stocks, 20 plants each of 12 other varieties were planted in sterilized soil and then inoculated with the nematode.

The roots affected with nematodes almost always show also a growth of fungus mycelium, probably a species of Fusarium. The relation of this fungus to the nematode and to the damage of the trees is also being studied in the field and in a special series of pot cultures.

The relation of the nematode to Mottle Leaf has not yet been demonstrated, but the experiments under way should within the next year give fairly conclusive evidence on this point.

A Study of the Relative Influence of Different Factors on the Composition of Certain Fruits and Nuts.—During the year analyses have been made by Mr. H. D. Young of Navel oranges from the different plots in the fertilizer experiments at the Riverside Station. These plots furnish an excellent opportunity to discover whether or not it is possible to affect the quality of the fruit by changing the fertilizer applied, since in the twenty plots nearly every combination of the usual fertilizers is found. From this, the first year's work, it seems that the effect on the recognizable qualities, such as sweetness and acidity, is very slight. However, although the fruits from the individual trees showed great variation, the average of the plots receiving potash alone showed the fruit to be a little sweeter than that from the other plots. Of the plots receiving only one of the usual elements of fertility, the phosphoric acid plots ranked second in sweetness, the nitrogen plots, third. One of the most striking things shown was that the juice of the fruit from the plots receiving nitrogen in any form, uniformly showed a higher per cent of nitrogen.

The possible relation of the rootstock on the fruit has also been under investigation chemically. Navel oranges grown on sweet stock were found to have more sugar and less acid than those grown on sour stock. Fruit from trifoliata stock had less of both sugar and acid than either of the others. It also produced a slightly firmer fruit. The continuation of this investigation for several years should give conclusions of considerable value.

A Study of the Freeze of January, 1913.—A study and observation on the effect of the freeze of the winter of 1913 has been continued during the year. While the principal portion of the work was concluded by the fall of 1913, the publication of the studies has been delayed to await the full recovery of the groves under observation. With the fine growth thrown out by the trees all over the state this spring, the recovery may be said to be complete and the results of the study will now be tabulated and published as early as possible.

A picnic is held annually at the University Farm.

AGRICULTURAL CHEMISTRY

BY

JOHN S. BURD

Fertilizer Control.—The Fertilizer Control work, consisting of the inspection of fertilizers found on the market throughout the state, together with samples received from consumers, has continued as usual, and about six hundred samples of such materials have been analyzed in the laboratory. Experience has shown that examinations of approximately this number are sufficient to maintain on a high basis the standards under which fertilizers are being sold.

Examination of Water.—During the year the service rendered in the matter of examination of water supplies has been entirely reorganized and the attempt has been made to make it more useful. Owing to technical questions in connection with the interpretation of the results of water analyses and to the lack of information on the part of the public with regard to same, it is difficult to render the maximum service without undue waste of time on the part of members of the staff. On this account it is undesirable in many cases to make complete analyses as frequently requested by our correspondents. It has, therefore, been determined to inaugurate the system of making partial analyses which shall be as comprehensive as is justified by the character of the sample submitted, reserving the complete analyses for those waters whose properties would otherwise be in doubt. The total number of complete analyses which will have been made approximates one hundred and seventy-five, in addition to about fifty samples upon which a partial analysis has been made. In connection with these water analyses it has been possible frequently to condemn waters which were unsuitable for specific purposes and to give warnings and advice with regard to the utilization of other supplies.

Research.—Three projects have been inaugurated during the year to which all of the members of the staff have devoted considerable of their time, Professor Stewart's time being exclusively devoted to this work. These projects are:

Investigation of the Moisture Content and Fertilizing Value of the Principal Kelps Found on the Coast of California.

Investigation of the Nature and Commercial Value of the Proximate Principles and Distillation Derivatives Present in the Principal Constituents of Kelp—Nitrogen and Potash.

Investigation of the Agricultural Value of the Major Fertilizing Varieties of California Kelp.

These projects comprise the various phases of a comprehensive study of the agricultural and commercial utilization of kelp and have indicated the possibilities and limitations of this material in the above connections.

AGRICULTURAL EDUCATION

BY

W. G. HUMMEL

The instructional work of the division has included the giving of courses in agricultural teaching methods at the University during the summer session of 1913 and during both semesters of the 1913–1914 college year. It has also included the conduct of correspondence courses in agriculture prepared by members of the faculty of the College of Agriculture.

Correspondence Courses in Agriculture.—In September, 1913, the first four correspondence courses in agriculture were ready for students. Eleven are now completed. Twenty-one other courses have been announced as in preparation.

The courses now ready for students are as follows:

Alfalfa culture (Course no. 1)	ready Sept. 18, 1913
Grape growing (Course no. 23)	ready Sept. 18, 1913
Citrus fruits (Course no. 24)	ready Sept. 18, 1913
Walnut culture (Course no. 21)	ready Sept. 26, 1913
Poultry husbandry (Course no. 14)	ready Oct. 20, 1913
Fig culture (Course no. 26)	ready Nov. 20, 1913
Onion culture (Course no. 5)	ready Dec. 16, 1913
Swine husbandry (Course no. 11)	ready Mar. 10, 1914
Barley culture (Course no. 8	ready Mar. 17, 1914
Olive growing (Course no. 25)	ready Mar. 30, 1914
Home floriculture (Course no. 27)	ready Mar. 30, 1914

The first correspondence course lesson was sent out September 18, 1913. From that time up to April 30, 1914, 31,605 lessons have been sent out.

The present (April 30, 1914) enrolment in agricultural correspondence courses ready for students is 6743. Of this number 5986 are taking their first course; 599 are re-enrolments. Two hundred and forty-seven students are taking their second course; 28 a third course; 4 a fourth course; and 1 a fifth course. One hundred and fifty-eight students have completed one course, but have not enrolled in another

as yet. Since some students have taken several courses, the actual number of different correspondence course students reached so far is 6424. Thirteen hundred and sixty-six students are enrolled in courses not ready. A total of 7790 different students are enrolled in courses ready and in preparation. A total of 8109 registrations have been received for the various courses.

Many students apply for registration in more than one course at a time; but they are permitted to enroll in one course only until that one has been completed.

The character of students reached by the correspondence courses is indicated by the following statistics as to their occupations. Out of a total of 6424 students enrolled up to April 30, 1914, in courses ready for study, 2390 are farmers; 550 are housewives; 113 are engineers; 924 are tradesmen and mechanics; 128 are merchants; 249 are professional men; 242 are teachers; 816 are clerks, stenographers and bookkeepers; 150 are brokers, real estate and insurance men; 233 are students; 629 occupation unknown. That is, 37 per cent are actually engaged in farming; 9 per cent are housewives, many of whom are farmers' wives; 2 per cent are engineers; 14 per cent are tradesmen and mechanics; 2 per cent are merchants; 4 per cent are professional men; 4 per cent are teachers; 11 per cent are clerks, stenographers and bookkeepers; 3 per cent are brokers, real estate and insurance men; 4 per cent are students; and 10 per cent, occupation unknown. Many of those classed among professional men own farms now rented.

The opinion of students as to the value of the correspondence course work to them is indicated by their letters to be of a most satisfactory character.

The average age of students is estimated to be 33. This estimate has been arrived at by averaging the ages of the first hundred correspondence course students in each thousand enrolled.

Enlisting the interest of large numbers of ambitious students scattered throughout the state at this age of high capabilities, and giving them practical, scientific information as to the best methods of conducting different agricultural enterprises, should give no small impetus to agricultural progress in the state.

Correspondence course students are enrolled from every county in California except Alpine. They are also enrolled from thirty-four States, Alaska and Hawaii. There are students in Japan, Greece, Mexico, Canada, Cuba, the West Indies, and the Fiji Islands.

Talks and Lectures.—Among the extension activities of this Division, the work of Assistant Professor Kern deserves special mention. He has given very nearly half of his entire time to talks and

lectures on education for country life. These talks total, up-to-date, 82. Of these 60 were to general audiences, 18 to teachers' associations, and 4 to farmers' institutes.

Professor Kern's work has been of great value in arousing interest in and enthusiasm for better country schools and a richer country community life in this state. It is desirable to continue these talks on education for country life until at least a few people in every country community in California have a vision of that community's possibilities. There must also be begun definite, constructive work for country schools and the communities which they serve.

Definite, practical suggestions for rural school and rural community improvement will be offered by this division whenever requested.

Investigational Work.—An investigation with regard to the use of land in connection with agricultural teaching in high schools, started during 1912–1913, was continued during the present year and much additional information was secured, especially as to the use of home land by high school agricultural pupils as a part of their school work. Valuable material was also collected with regard to the use of land by Normal and other secondary schools teaching agriculture.

The right use of land in connection with high school agricultural teaching is undoubtedly one of the most important and difficult problems with which agricultural teachers have to deal. It is frequently the least successful phase of the agricultural work in high schools. Yet, if agricultural instruction in high schools is to accomplish what is claimed for it, it must be accompanied by successful, educational use of land, either at home or at school.

Agriculture in California Schools.—According to reports so far received, sixty-one high schools are now teaching agriculture, an increase of ten over 1912–1913. The courses vary from one to four years in length.

Reports from thirty-four county superintendents state that agriculture or agricultural nature-study is being taught in some of their elementary and grammar schools. Three county superintendents have reported that no instruction which could be termed agricultural is given in their schools.

School garden work is reported in thirty-three counties.

AGRICULTURAL EXTENSION

BY

W. T. CLARKE

Farmers' Institutes.—The work of this division has covered a number of activities. During the year 205 Farmers' Institutes have been held in 41 out of 58 counties of the state. The total attendance at these Farmers' Institutes was 37,356, or an average attendance of 182 per institute. At these institutes the subjects of present actual importance in the communities where they were held were discussed by experts from the College of Agriculture and Experiment Station.

Movable Schools.—Two Movable Schools or Extension Schools have been held in communities where dairy and animal industry problems were of very considerable importance. These schools were held at Modesto and Turlock and the instruction given at them was intensive and well calculated to assist the interested farmers in better handling their dairy herds. The total attendance at these two schools was 2200; the average attendance per day was 183.

Agricultural Clubs (Adults).—Feeling that the extension work would be more permanent and a more satisfactory result obtained if the farmers, both men and women, in various neighborhoods could be well organized, there has been established 13 agricultural clubs in seven counties of the state, with a total membership of 460. These clubs are very active and during the ten months in question have held a total of 155 meetings. At these meetings occasionally representatives of the College of Agriculture have appeared and have addressed the members and invited guests on agricultural topics that were considered important in the regions where the meetings were held. These clubs have also carried on a considerable amount of work without the College of Agriculture's representatives being present. This work has consisted of the presentation of papers on different subjects and the discussion of these papers. Many of the papers in question have come into this office and indicate a very careful and well studied interest in the subjects discussed.

High School Agricultural Clubs.—The agriculture of the state for the future depends absolutely upon the development of intelligent

workers. These workers must come from our schools and colleges. Through the enthusiastic action of the agricultural club of this college acting in co-operation with the Extension Division, agricultural clubs have been established in 84 high schools of the state. These are distributed through 30 counties and have an average membership of 15, making a total of 1260. This work is being pushed energetically and there will undoubtedly be very considerable additions to this number of clubs in the ensuing twelve months.

Fort Bragg Potato Club boys in their plats. May 26, 1914.

Fairs.—The College of Agriculture of the University of California has been represented at nine fairs in California in the past ten months. At these fairs exhibits have been presented, showing forth the investigational and educational work being done by the college and station. A total attendance has been noted of 88,151 of these individuals. The station and college was also represented at the National Corn Exposition at Dallas, Texas. At this exposition, held in February of the current year, 37 of the experiment stations and colleges of agriculture of the United States were represented, as was also the United States Department of Agriculture. A careful estimate of the number of visitors actually passing through the exhibit of this institution and asking questions of the demonstrators in charge thereof gives a total of 20,000 visitors there.

Personal Visitation.—While the great majority of questions raised by our correspondents and visitors have been answered by letter without further data than that given in these letters or conversations, in certain cases it has been necessary for members of the extension staff to make personal visits to various properties situated in different parts of the state, and examine these properties for the benefit of the persons interested therein. This particular work is of considerable value, inasmuch as the advice offered is of such a nature as to assure the individual interested in the land of its value or its lack of value, and to post him as to methods of handling either the land or the crop growing upon the land. Eighty such examinations have been made in the ten months under consideration.

To recapitulate, the department has been in direct touch with various individuals in the state and without the borders of the state as follows:

Through Farmers' Institutes	37,356
Through movable schools	2,200
Through agricultural clubs	460
Through high school agricultural clubs	1,260
Through fairs	108,151
Through letters	25,301
Through land examinations	80
Through Ministers' Week	501

giving a total of 175,309 individuals actually in touch with this institution through our Extension Division during the past ten months.

County Farm Advisers.—Quoting from circular No. 112, January, 1914:

"It has been said that the agricultural institutions of the country are like a great manufactory grinding out a product of infinite value which has been stored in warehouses far from the consumer that the product was designed to reach. Lacking a retail force of agents, this product continued to accumulate without greatly affecting the consumer and his wants. Like the manufactory, the agricultural institution must have its agents close to the point of consumption so that the product may be readily placed in the hands of those who need it. These agricultural agents are now being established throughout the nation under the name of 'County Farm Advisers.' They act as the necessary force to bring the information of the agricultural colleges, experiment stations, and the national department of agriculture to the specific farmer who needs it.

The farm adviser is an agent both of the College of Agriculture of the University of California and of the Office of Farm Management, United States Department of Agriculture. He is placed in a county where his services are desired. His entire time and activity are spent there within the boundaries of that county. There he is the field agent of the agricultural forces of the nation.

The farm adviser is interested in good results wherever he finds them. He may carry the methods of the best farmers from ranch to ranch. On the left barley grown by ordinary methods; on the right by summer fallowing and early planting.
(Mr. M. T. Popplewell, Supt. Jamul ranch.)

The farm adviser has an office or headquarters at some central point in the county, usually at the county seat. He may also, through the organization of a farm bureau, find it desirable to have other local or district headquarters at scattered places throughout the county.

Day by day the farm adviser goes where he is called, advising on the various questions that come to him. When, as is sometimes the case, he meets a problem that to him is impossible of solution because of the technical phases involved, he submits it for consideration to the agricultural college or to the federal department of agriculture, the forces of both of which he has at his command.

A farm adviser writing the formula for lime-sulphur wash on the barn door. A note-book is sometimes lost, not so the barn door.

Specifically, the work of the farm adviser may be divided into four general branches, as follows:

(1) Investigation or research into the larger problems of farm management as applied to that specific community.

(2) Demonstration or application of these principles and practices through the co-operation of interested farmers.

(3) Advisory work with inquirers, that is, the answering of questions and giving of advice to those who apply.

(4) Organization work of the civilizing forces of the community—assistance to boys' agricultural clubs, farmers' organizations, schools, churches and marketing, and buying organizations.

The work of the farm adviser is supervised by a state leader, appointed jointly by the College of Agriculture and the United States Department of Agriculture, to which he makes weekly reports.

The farm adviser's salary is paid by the College of Agriculture of the University of California. His expenses are paid by local agencies within the county.

About two thousand dollars a year is estimated to be necessary in most cases for the expenses of the farm adviser. These mean the maintenance of an office and office facilities, the use of a small automobile for travel within the county, and the subsistence of the farm adviser while away from home.

In order to facilitate the work of the farm adviser and to conserve his time as much as possible, it is desirable that some permanent organization be in advisement with him regarding problems of the county. Such an organization is a farm bureau as organized in many parts of the United States. The farm bureau is the organization of farmers around certain local district headquarters where the farm adviser is due at definite intervals and times for consultation with the members of the bureau and for demonstration on their farms of the methods under discussion for their county."

AGRONOMY

BY

JOHN W. GILMORE

It is considered that the activities of this division should be directed along three general lines: First, instruction to regularly enrolled students at Berkeley and at Davis. Second, a line of activities which may be termed, though not administered, as extension work. This comprises correspondence, mainly in answer to inquiries for information on all lines pertaining to crop production, conferences with landholders and students regarding problems and policies of land management and crop production. Third, investigations bearing upon the principles and practices in crop production.

One phase of the division activities, especially in all of its offices, are the conferences. Members of the instructing staff invite students who may want further information upon the subject of their study or information along special lines to come into their office for individual consultation. There are, in additon to this, a considerable number of callers who come both to the offices as well as to the stations for conference and inspection regarding their particular problems.

Investigations.—The investigation and research work of the division is carried on at localities and under circumstances designated as follows:

The University Farm School at Davis, 40 acres, as previously reported, with an addition of 40 acres to be used in dry farming operations during the coming year.

At Kearney Park, 20 acres being a portion of the Kearney Estate.

At Meloland, Imperial Valley, on 40 acres, a gift of the county.

At Berkeley on small areas set aside and in the greenhouses of the division.

At large in several portions of the state chosen for climatic or soil considerations.

In co-operation with the Department of Agriculture at Middle River and at Biggs.

At University Farm, Davis.—It is deemed desirable to consider the experimental grounds at Davis as the principal headquarters for investigational work. At this station investigations are planned to cover in general longer periods of time and as pertaining more particularly

to the fundamental principles involved than at the other stations. Davis is, therefore, the principal seat of investigations in the soil, moisture and crop conditions under dry farming methods, also the influence of fertilizers upon soil and crops and the principles involved in rotations, diversifications, and green manuring.

At the present time there are being conducted at the University Farm projects which may be mentioned as follows:

Variety Trials.—The variety trials with cereals are carried on in two groups: (1) Nursery or row planting, and (2) Plat plantings.

The nursery plantings include row trials with 58 varieties of wheat, 38 varieties of barley, and 37 varieties of oats. Besides these, 52 strains of hybrid wheat are being grown, as well as 58 improved strains of wheat, barley and oats increased from centgeners.

The plat experiments include 62 varieties and strains of wheat, 36 varieties and strains of barley, and 18 varieties of oats.

Fertilizer Experiment.—The fertilizer experiment, composed of 27 one-twentieth acre plats, which was originally designed to determine the effect of various kinds and combinations of commercial fertilizers upon the composition of wheat, was continued this season. As is the case with the variety trial, some of the plats suffered from the heavy rain early in the season, so that the stand is not uniform.

Breeding Experiment.—As in previous years, the work of cereal improvement has been conducted largely by the centgener method. While some very good results have been obtained, many of the strains have given very erratic results. In conjunction with this work, it is planned to begin selection from pure strains in comparison with the centgener method. Head selection from field plantings will be made for this purpose this season, as it is thought that this method, permitting the use of large numbers, will be more productive of results.

Rotation Experiments.—The old rotation experiment designed to determine the effect of summer fallow and green manure crop upon the yield of wheat has been replaced by a more extensive project. The experiment as it now stands includes continuous cropping with nearly all dry-farm cereals and forage crops, as well as rotations combining the use of the various cereals, forage crop, green manure crops, and summer fallow. Moisture determination will be made upon the soil of each plat, at given intervals during the season, to ascertain which system of cropping is most economical of water. The first samples for moisture determination were taken March 5th to 10th, following an extremely wet winter, while the soil was nearly saturated; the results showed a marked difference in the water-holding capacity of the various soil strata.

Chemical analysis will also be made upon the soil of the various plats from time to time to determine the effect of the different cropping systems upon the humus content of the soil and the intensity of nitrification. This project is composed of 52 one-twentieth acre plats, the crops on all of which are in good condition.

Climate and Soil on the Composition of Wheat.—Two experiments in co-operation with the U. S. Department of Agriculture and Kansas, Texas, South Dakota and Maryland, designed to determine the effect of climate and soil upon the composition of wheat, are continued. Climate seems to have had the greatest influence on composition, while the soil, especially with regard to its moisture-holding capacity, exerted the greatest influence on yield.

Winter Legumes.—An experiment to determine the comparative value of the various varieties of winter legumes for seed and forage and green manure purposes was inaugurated this season on a somewhat more extensive scale than in previous years. It includes 14 varieties of field peas in plats and 11 in row plantings and 28 varieties of vetch and miscellaneous legumes. In spite of the fact that the heavy rain of the winter delayed seeding, all plats are in excellent condition.

Alfalfa Experiment.—Two small experiments with alfalfa have been started. In the spring of 1913 a breeding nursery was set out. The seed used had been hand picked from promising plants of the leading varieties, namely: Chilean, Turkestan, Arabian, and Peruvian. This season (1914) a few of the Siberian varieties have been added to this list. As soon as the plants reach maturity, seed selection, as well as improvement by vegetative propagation, will be undertaken. The second experiment is designed to determine the effect of commercial culture for inoculating alfalfa seed, and also to determine the effect of winter cultivation of the crop. The four leading varieties given above are being used.

Cow Peas and Beans.—A variety experiment with cowpeas and beans, both in plats and in rows, has been started. The work on the cowpeas will be carried on in the same manner as with the winter legumes. In the case of the beans, plat plantings are being made of the leading varieties of the state. With the other varieties only row trials will be conducted.

Sudan Grass.—The Sudan grass experiment started in April, 1913, through the co-operation with Professor C. V. Piper of the Bureau of Plant Industry, was continued this year. During 1913 the crop adequately demonstrated its ability to withstand drought, as the growth upon the dry culture plats was greater during the latter part of the summer, when the roots had had time to develop, than it was earlier

in the season. The yield of hay on the dry culture plats was 3.3 tons per acre and on the irrigated plats about eight tons per acre.

The experiments this season will be conducted along lines similar to those of last year to determine its value both as a forage crop and for seed purposes. Plats are being seeded at various dates, both broadcast and drilled, in rows different widths apart, and both with and without irrigation.

Sorghums.—Owing to the general interest in the various sorghums as grain and forage plants, and to their adaptability to dry farm purposes, extensive investigations have been undertaken with this crop. The project includes plat and row plantings with 35 varieties and strains of grain sorghums, and ten varieties of saccharine sorghums. Some work with the sorghums has been done in previous years, but not of a sufficiently largely scale to furnish conclusive data. Results obtained tend to show that of the grain sorghums the Dwarf Milo and the Sudan Durra, or Feterita, are the heaviest producers of grain.

Corn.—The work with corn has been largely in the nature of variety trials. Results of previous years have shown U. S. No. 160, Minnesota No. 13, Leaming & Reid's Yellow Dent to be among the best varieties for this State. The difficulty in the past has been to secure pure seed, necessitating the introduction of new seed each season. It is proposed to overcome this difficulty by hand pollinating enough ears of the most promising varieties to provide seed for the next year's plantings, inasmuch as the success of the varieties often depends upon their becoming acclimated to local conditions. The project includes 46 varieties and a few cultural experiments to ascertain the effect of cultivation and the effect of different rates and methods of planting upon yield.

Potatoes.—In the spring of 1914 work with potatoes was begun, including variety trials, cultural experiments and seeding tests. The results are expected to throw some light upon the varieties best adapted to certain localities of the state as well as to determine the most desirable cultural methods. The laboratory work incident to the experiments, which was formerly done at Berkeley, has been transferred to Davis, the general soil laboratory being used temporarily for this purpose.

At the Imperial Valley Experiment Farm.—Fifteen projects have been approved and fourteen of these have been reported upon. These projects include variety trials of grains and other field crops, rotation and fertilizer trials, irrigation and cultural experiments.

In addition to the above, several projects have been outlined and much work done. Some of these were begun before the new system of

projects was adopted and no project outlines are made as yet. They include variety trials of citrus and deciduous fruits (Co-operation between the Divisions of Citriculture and Agronomy); variety trials of grapes and cultural experiments in vineyard (Co-operation between the Divisions of Agronomy and Viticulture); Irrigation Investigations (Co-operation between the Division of Agronomy and the U. S. Irrigation Investigations).

Weather records have been kept since January 1, 1914. These include maximum and minimum temperature records, humidity, rainfall and evaporation readings. The instruments are kept in a standard house built for the purpose.

University of Califorina Agricultural Experiment Station, Meloland, Imperial County, California.

The Experiment Farm is fast becoming a center of interest among the ranchers. The auto stages which pass every half hour make the farm very accessible, and the visitors have very greatly increased during the past year. Over 200 people visited the farm between January 1, 1914, and April 1, 1914. No record was kept prior to that date. The main questions were on soils, irrigation, dates, alfalfa, cotton and fruit in general. In many cases visitors take from an hour to two hours' time. The number of landowners about equals the number of prospective buyers among the farm visitors. The above does not include the inquirers on live stock matters.

Farms were visited upon request when time permitted. Twenty-two farms were visited in various parts of the valley to consider soil

problems. In eleven cases soils were tested for alkali and results reported. Two farms were visited to investigate truck garden problems and two for tree pruning.

Institutes.—The plan of holding farmers' institutes in the valley was changed this year, and instead of holding general institutes in the various towns as heretofore institutes were arranged in the various schoolhouses. Seventeen institutes were arranged and held with an average attendance of 37.5 per session. The average attendance of adults was 30.5. The evening sessions proved to be the best by far, the average attendance being 47. In many cases nearly all of the farmers in the district and some from neighboring districts were in attendance, and in every case much interest and enthusiasm was shown. Permanent farmers' clubs were organized in some of the districts where such an organization seemed feasible.

Institutes were held in the following places:

School District	Date	Attendance afternoon		Attendance evening	
		Adults	Children	Adults	Children
Fern	4/23/14	No meeting		60	2
Mulberry	4/14/14	30		75	
Bard	2/28/14	60		70	
Mt. Signal	2/23/14	13	20	30	15
Meloland	12/13/13	6 (Conflict)		49	20
Alamitos	12/12/13	15	12	29	8
Elm	10/24/13	11	5	19	5
Jasper	10/25/13	No meeting		25	3
Eucalyptus	11/1/13	11	25	41	14
McCabe	11/6/13	19	25	31	5
Wideawake	11/7/13	5	12	13	1
Magnolia	11/13/13	22	18	48	22
Central	11/14/13	34	20	72	30
Eastside	11/29/13	19	20	49	5
Alamo	11/28/13	10		32	
Dixieland	12/6/13	11	5	45	10
Westmoreland	12/–/13	28	15	48	5
		294	177	736	163
		177		163	
	Total,	471		799	

Special institutes were held on the Experiment Farm to cover subjects of particular interest to certain ranchers.

At Kearney Park Experiment Station.—At this station there are five permanent experiments in progress. They were started in 1910, and their value increases with the length of time they are allowed to run. They are as follows:

Rotation Without Fertilizers.—This is a three-year rotation experiment as affecting soil fertility, no fertilizers of any kind being used. Three plots are each planted every year to one of the three crops. They are wheat, sorghum, and roots. This year the wheat plot was planted to Bob's wheat in December. The sorghum plot was planted April 23 to Feterita. The root plot was planted to Long Red Mangels on April 28.

Rotation With Fertilizers.—This is similar in every respect, except that all the plots are fertilized every year, either with stable manure or by plowing under a green manure crop. This year the wheat plot had an application of stable manure, while the sorghum and root plots had cover crops of legumes plowed under.

Annual Versus Biennial Cropping.—This is a fertility experiment in annual versus biennial cropping of wheat. At the present writing there is a visible difference between the two in favor of the biennially cropped plot. They were both planted to Bob's wheat in December.

Cultural Methods.—This is a cultural experiment with two biennially cropped plots of barley. Both are plowed to the same depth of six to eight inches. One is worked down to a seed bed with the harrow only, while the other has a Campbell sub-surface packer run over it at right angles to the furrows, and is then finished with the harrow. Both were planted to Tennessee Winter barley in December. There is no visible difference in the stand at the present writing.

Depth of Plowing.—This is a cultural experiment in deep versus shallow plowing. A biennially cropped plot is plowed to a depth of four inches only, and otherwise treated in exactly the same manner as the plot in Experiment No. 4 without the sub-packer. It is planted to the same crop at the same time also, so that comparison can be made between the two. There is no visible difference in the stand at the present writing.

The permanent experiments have not run long enough yet to warrant any definite conclusions. Last year the annually cropped plot of wheat yielded more than the wheat plot in the three-year unfertilized rotation experiment. The yields in bushels per acre of the wheat plots in the first three experiments last year were as follows:

Three-year rotation, unfertilized	10.22
Three-year rotation, fertilized	24.38
Annually cropped	26.98
Biennially cropped	35.04

In connection with the rotation experiment with fertilizers, thirteen varieties of legumes were planted as a cover crop on one of the plots.

Before plowing under March 20 sixteen feet of one row of each variety were cut close to the ground and weighed green. The names and green weight of each variety are as follows:

Fenugreek	5 lbs.	12 oz.	Lathyrus Cicer	5 lbs.	12 oz.
Lathyrus Sativus	6	14	Lathyrus Tingitanus	5	12
Lathyrus Clymenum	6	13	Lathyrus Coccinus	4	14
Vicia Fulgens	6	12	Vicia Sativa	6	6
Vicia Calcareta	7	4	Vicia Ervilea	5	....
Canadian Field Pea	6	4	Niles Field Peas	11	....
Mexican Field Pea	8	....			

One of the most serious problems of the station is the eradication of Johnson Grass. It is pretty well established all over the thirty acres of the station experimental grounds, and an effort is being made to eradicate it. Different portions of the station will be withdrawn from culture for one year as they can be spared. A weed cutter has been purchased which cuts off the stalks at about two or three inches below the surface of the ground. This will be used on the area set aside every eight or ten days to keep the growth down. This year eight plots are being gone over in this manner. Meantime the Johnson grass on the other portions of the station is being kept down by hand as well as possible.

Another experiment is being conducted this year in co-operation with the Division of Soil Technology. A well or sump fourteen feet deep has been dug and a three-inch centrifugal pump installed. By means of a float switch this pump will keep the water in the well down to a depth of twelve feet or lower. At present the water in the well stands at about six feet from the surface. Sixteen test wells have been sunk radiating out from the sump, the four farthest being 600 feet distant. The depth to the water in these wells will be measured once a week. In this way it can be determined how far reaching is the effect of a pumping plant on the water table.

Other investigations than those already mentioned comprise work being conducted at Berkeley, mainly in the growing of cereals and forage crops in a large number of varieties for classroom material and upon which observations and records of growth are taken.

Preliminary plans have been laid for comprehensive investigations in forage crop and range conditions in several parts of the state. Preliminary arrangements are also made for obtaining from a large number of sources, records and data bearing upon the cost of land management and crop production.

The Division of Agronomy, co-operating in a consulting capacity with the U. S. Department of Agriculture in general cropping experiments at Middle River, which locality represents the conditions existing at large in the delta region is also in co-operation in the same manner with the department in the rice investigations that are being conducted at Biggs.

The dairy herd of the University Farm consists of four Ayrshires, twenty-five Guernseys, thirty Holstein-Friesians, and twenty-one Jerseys.

ANIMAL HUSBANDRY

BY

GORDON H. TRUE

Three members of the division acted as judges at eight different county fairs, a work distinctly educational in its character and much appreciated by the fair managers and people in attendance.

Exhibits of live stock were made at the California State Fair and at the Pacific International Live Stock Show at Portland. At the State Fair, 35 animals exhibited by the division were awarded premiums consisting of 32 firsts, 8 seconds, 5 thirds, 2 fourths, 1 fifth, and 11 championships, or a total of 59 prizes. At Portland 17 animals were awarded 8 firsts, 9 seconds, 1 third, and 5 championships, or a total of 23 prizes. The division feels that in making these exhibits it is not only giving the people of the state an opportunity to judge something of the work of the school and giving its students and employees a needed opportunity for practice in the art of fitting stock for show and of exhibiting the same, but that it is following the best practice of progressive breeders who feel the need of this annual judgment of their work in comparison with that of other breeders, at the hands of skilled and disinterested judges.

During the first nine months of this fiscal year the division has sold 57 head of breeding stock to farmers of the state and referred inquiries to other breeders resulting in sales by them.

No record has been kept of the number of visitors to the division during the year, but probably no less than five hundred persons have come seeking personal advice. The division has tried never to be too busy to give all necessary time to such people, as this appeals to it as being one of the most effective opportunities for service.

The work done in conducting official tests of dairy cows for production of milk and butter fat has been recently added to the duties of this division, Professor F. W. Woll having been placed in charge, with Miss C. J. Hill as assistant. A larger number of tests has been conducted during the current year than in any previous similar period, and new breeders are taking up this testing work each month. The tests are becoming of increasing direct value to the breeders every year, as records of production are more and more being made a con-

dition of purchase of dairy stock, and the prices which stock can command are largely dependent on the records made in tests conducted by the agricultural colleges.

Official tests are conducted in co-operation with the various dairy breed associations and are of two kinds—seven or thirty days' duration, conducted almost wholly with Holstein cows, and monthly tests of two days' duration, conducted with Guernsey, Jersey, and Holstein cows. The large proportion of tests of the latter class which are conducted for yearly records of production, is a most encouraging phase of the work in this state.

The following statement shows the number of breeders for whom tests were conducted during the year, the number of cows tested, and the records of 21 pounds of butter fat or more for seven consecutive days, which were made by California cows during the past year:

OFFICIAL TESTS OF DAIRY COWS, JULY 1, 1913–MAY 1, 1914

Name and address of breeder	No. of cows on test for period given					
	Year	7 days	14 days	30 days	60-100 days	Totals
Ayrshires—						
University of California, Davis	1	....	....	....	....	1
Guernseys—						
W. H. Dupee, Santee	14	....	....	....	....	14
	....	3	....	....	....	3
	15	3	00	00	00	
Holsteins—						
K. W. Abbott, Milpitas	....	4	....	....	....	4
B. F. Anderson, Modesto	1	1	....	....	....	2
J. W. Benoit, Modesto	1	13	....	....	....	14
H. E. Cornwell, Modesto	....	1	....	....	....	1
J. S. Gibson Co., Williams	....	2	....	....	....	2
R. F. Guerin, Visalia	....	9	....	....	....	9
L. A. Hall, San Jose	4	8	....	....	....	12
Miss M. M. Holdridge, Modesto	....	25	7	....	....	32
Leland Stanford Junior University (Vina Ranch), Vina	....	3	....	....	....	3
M. A. MacLean, Modesto	....	9	....	....	....	9
H. L. Martin, Modesto	....	2	....	....	....	2
E. O. McClure, Modesto	....	3	....	....	....	3
J. McGillivray, Sacramento	....	6	....	....	....	6
A. W. Morris & Sons Corp., Woodland	75	74	3	17	4	173
D. and H. Rowles, Modesto	....	2	....	....	....	2
G. A. Smith, Corcoran	3	3	....	....	....	6
E. A. Stellar (Merci Ranch), Modesto	....	1	....	....	....	1
University Farm, Davis	7	7	....	....	....	14
Watson Bros., Dixon	....	1	....	....	....	1
	91	174	10	17	4	

OFFICIAL TESTS OF DAIRY COWS, JULY 1, 1913–MAY 1, 1914—*Continued*

Name and address of breeder	Year	No. of cows on test for period given: 7 days	14 days	30 days	60-100 days	Totals
Jerseys—						
X. Carrithers, Tulare	12	....	....	....	....	12
D. F. Conant, Modesto	8	....	....	....	....	8
L. J. Dobler, Turlock	10	....	....	....	....	10
J. A. Goodall, Turlock	2	....	....	....	....	2
W. J. Hackett, Ceres	12	....	....	....	....	12
C. D. Hayworth	10	....	....	....	....	10
G. O. Hillier, Modesto	15	....	....	....	....	15
A. A. Jenkins, Tulare	2	....	....	....	....	2
G. F. Kendall, Ceres	5	....	....	....	....	5
G. McFarland, Tulare	3	....	....	....	....	3
G. H. Miller, Modesto	11	....	....	....	....	11
C. N. Odell, Modesto	12	....	....	....	....	12
J. F. Snover, Ceres	8	....	....	....	....	8
University Farm, Davis	2	2	....	....	....	4
	112	2	00	00	00	

RECORDS OF PRODUCTION MADE DURING SEVEN CONSECUTIVE DAYS

Name of Cow	Age	Milk lbs.	Butter fat lbs.	Butter fat av.%	Owner
Mable Haskins of San Jose Jose 40957	4½	680.1	26.213	3.85	K. W. Abbott, Milpitas
Luit Burke 197331	4⅛	483.3	26.204	5.42	A. W. Morris & Sons, Woodland
Balo Canary Mercedes Burke 129048	4¾	490.7	25.425	5.18	A. W. Morris & Sons, Woodland
Jane Korndyke of Riverside 93925	7	575.8	24.972	4.34	A. W. Morris & Sons, Woodland
Tilly Alcartrs 123459	5¼	715.4	23.412	3.27	A. W. Morris & Sons, Woodland
Wisconsin Daisy of Sleepy Hollow 133794	4½	619.4	23.925	3.86	L. A. Hall, San Jose
Tula De Kol Pietertje Netherland 106233	2	502.6	22.729	4.52	Miss M. M. Holdridge, Modesto
Natula Fobes 2d 152267	3⅛	436.0	22.293	5.11	A. W. Morris & Sons, Woodland
Riverside Sadie Burke 99697	6¾	413.7	22.000	5.32	A. W. Morris & Sons, Woodland
Sleepy Hollow Meditation 110832	5½	651.3	21.151	3.25	Miss M. M. Holdridge, Modesto
Mary King of Riverside 93943	7	408.4	21.128	5.17	A. W. Morris & Sons, Woodland
Wilhelmina Gerben DeKol 103374	4½	444.6	24.341	5.47	A. W. Morris & Sons, Woodland

Experimental Work.

The following investigations conducted by this division have been completed during the year or are in progress at the present time.

Ground Barley as Supplementary Feed to Alfalfa.—The experiment was conducted from July 24 to October 7, 1913, with 14 cows in the University dairy herd. When fed barley in addition to alfalfa hay, the cows produced 16.2 per cent more milk and 13.2 per cent more butter fat than when fed alfalfa hay only. They also gained 12 pounds more per head in body weight when fed barley and alfalfa than during the exclusive alfalfa period. At 16 cents per gallon for milk, $24 per ton for barley and 7 cents per pound for beef, a gain of $35.82 was thus secured, against an outlay of $31.43 for barley. This does not show the entire benefit derived from the feeding of grain supplementary to alfalfa, however, as the improved condition of the cows that came as a result of the grain feeding, doubtless, also had a beneficial influence on their production during the balance of the lactation period and during the next lactation, although no definite statement can be made as to the importance in this respect of the influence of the more liberal system of feeding.

Corn Silage as a Supplement to Alfalfa Hay.—Twenty-four cows separated into two even lots, were included in the experiment which was conducted from November 20, 1913, to March 5, 1914. Six cows in each lot received no grain feed in addition to alfalfa or alfalfa and silage, while the others received about five pounds per head daily in addition to roughage fed. The feeding of silage resulted in a gain of 22 per cent in milk, 10.8 per cent in butter fat, and 12.3 per cent in milk solids. At average prices for feed and products, the increase in production more than paid for the excess of feed eaten during the silage periods.

Metabolism of Fresh Milch Cows.—The investigation has so far been confined to a study of the relation between the body weights of fresh milch cows and the fat contents of their milk for two to three weeks after freshening. Six cows have been included in the trial so far. They have been weighed twice daily during the period given and the separate milkings have been tested for butter fat and solids. The investigation will be continued during the year with a view to determining the conditions under which certain cows may yield milk of abnormally high fat content immediately after freshening, and the relation between their body weights and the per cent of butter fat in the milk.

The Effect of Alfalfa as Exclusive Feed on the Development of the Dairy Cow and Heifer.—Six calves have been included in this investigation so far, and two more will be added in the near future, so that four heifer calves will be fed green alfalfa or alfalfa hay and four will receive mixed rations consisting of alfalfa and grain feeds with corn silage during the winter. Each lot consists of pure-bred representatives of the Jersey, Guernsey and Holstein breeds and one Shorthorn grade. The feed eaten by the calves will be weighed daily and careful records of their weights and growth as determined by measurements will be kept.

The Efficiency of the Hinman Milking Machine.—Sixteen cows in the University dairy herd were milked with the machine during four weeks from March 5 to April 2, 1914, and their production was compared with that during the preceding and following two-week periods, when the cows were milked by hand. Both machine-drawn milk and strippings were analyzed separately and observations of the time required for the machine and hand milking were also taken. The average time required for milking cows by machine was 10.9 minutes and .78 of a pound of milk was obtained per minute (strippings included). The corresponding data for hand milking was 4.3 minutes and 1.78 pounds. The cows produced 8.2 per cent less milk and 6.7 per cent less butter fat on the four-week period of machine milking than on the preceding and following two weeks of hand milking. On the average for the different cows, the machine left 1.2 to 6.8 pounds of strippings per day to be milked out by hand, containing 11.8 to 66.4 per cent of the total amount of butter fat produced by the cows; the average for all cows, 3.5 pounds strippings per day and 37.2 per cent of the total fat in these.

Cost of Hand Milking and Machine Milking in Commercial Dairies.—Data for only one dairy, Watson Bros. of Dixon, has been obtained at this time. Sharples Mechanical Milker was installed in this dairy about February 20, 1914. Time observations and weighings of milk were made on February 15 and on March 29 for machine milking. The average time for milking per cow by hand milking (3 men) was 6.79 minutes and on machine milking (2 men, 1 running 4 units and the other stripping) was 1.74 minutes; weight of milk per minute by hand milking 4.74 pounds, machine milking 6.23 pounds.

On the Value of Grain Feeds for Goats Fed Alfalfa.—Four milch goats loaned to the University by Mr. Winthrop Howland, of Redlands, Cal., a breeder of Toggenburg goats, are used in this experiment.

The goats kidded as follows: Delia, one-half Toggenburg, February 20, triplets; Geneva, pure bred, March 11, twins; Hedda, pure bred, April 11, triplets; and Delphine, three-fourths Toggenburg, April 12, twins. Two of the goats are fed green alfalfa or alfalfa hay only, while the other two receive grain feed in addition to the alfalfa. The production of milk, butter fat and solids by the goats is determined by regular weekly composite sampling and testing, as in the case of the cows in the University dairy herd, and the feed which they receive is weighed except when pastured. The investigation will be continued for at least a year.

Feeding Beet Pulp with Various Supplementary Feeds at Gilroy, Cal.—(In co-operation with Miller & Lux, Inc.) From December 23, 1913, to February 10, 1914, four lots of twenty-five steers each were fed as follows: Beet pulp all they would eat, and to lot I 15 pounds alfalfa hay, to lot II 20 pounds alfalfa hay, to lot III 7½ pounds barley hay. This lot made the largest gain; lot IV, fed rye grass hay and 2 pounds horse beans daily with beet pulp, made the second largest gain; there being but little difference in the gains made by lots I and II.

Feeding of Various Grains in Connection with Alfalfa Hay for Range Steers at Lovelock, Nev. (in Co-operation with Western Meat Company).—The object of these trials was to study problems connected with feeding of grain feeds to steers fed alfalfa hay under range conditions. The feeding trials were conducted October 30, 1913, to March 21, 1914, and included about 2000 animals in all, the number of steers in the different lots ranging from 199 to 236, with an average of 226 steers per lot. One lot also included 101 hogs following the steers and fed corn separately. The following grain feeds were fed supplementary to alfalfa hay: shelled corn, dried beet pulp, barley, Sperry Feed ("Sure Milk"), and cotton seed cake. The hay fed was chopped in all lots but two, which received long hay. The trials involved the feeding of over 1900 tons of hay and 550 tons (about 20 carloads) of grain feed in all, the total cost of the feed eaten by the steers exceeding $31,000.

Owing to the fact that the trials were brought to a close on different dates during January to March, 1914, and that the weather and other conditions varied greatly during the progress of the trials, it is not possible to make strict comparisons between the nutritive values of the different grain feeds in all cases, but most valuable results were nevertheless obtained on these trials, which are unique

on account of the large scale on which they were conducted and the variety of conditions covered by them. The best returns were obtained with barley and alfalfa hay, the average daily ration fed being 5.5 pounds of barley and 21.8 pounds of hay. The returns from the rations including Sperry's Sure Milk, beet pulp and corn decreased in the order given.

Watering place for hogs. Note the sheds for shade in the distance. They should be placed at a distance from the water to prevent the formation of mud-holes under them.

The Use of Supplemental Feed with Barley for Pork Production and the Comparison of Lard Hogs with Bacon Hogs for the Production of Bacon.—The experiment was conducted for 70 days during the summer of 1913, with five lots of 15 hogs each, four of which were mixed lots of Poland Chinas, Berkshires and Duroc Jerseys, and the fifth was Tamworths only. All lots were fed barley, which was the sole feed for lot I, and the other lots received in addition: Lot II, alfalfa pasture; lot III, alfalfa pasture and shorts; lots IV and V, alfalfa pasture, shorts and skim milk. The first four lots, which averaged 76 pounds each at the beginning of the experiment, made the following average daily gains per head: .75, .81, .85, and 1.27 pounds for lots I to IV respectively, while the pigs in lot V, which were thirty days older than those in the other lots and averaged 114 pounds each, gained 1.57 pounds daily.

Soiling vs. Pasture as Supplements to the Grain Rations for Pigs.—Fifteen 4½-months-old shoats, averaging 114 pounds at the beginning of the trial, have been fed barley in addition to green feed since February, 1914, one lot being on alfalfa pasture and the other being fed green alfalfa. The area of the pasture eaten by the hogs is measured and the green feed is weighed and the area likewise measured The results obtained up to the present time (April, 1914) did not indicate any appreciable difference in the gains made by the two lots.

Gifts.—From Mr. Allen A. Chickering, executor of the estate of Minna E. Sherman, a set of 28 volumes of the Holstein-Friesian

Pens for brood sows and their litters. The roof is of chicken wire covered with hay, an effective protection for hogs in Imperial County.

Register, 12 volumes of Advanced Registry of Holstein-Friesian cattle, 6 volumes of the Holstein-Friesian Year Book. These books are presented as a memorial of Mrs. Minna Eschleman Sherman, for years a leading breeder of Holstein-Friesian cattle, and at the time of her death a Regent of the University of California.

From the various registry associations the following:

American Shetland Pony Stud Book, Vols. 1–12.
National Register of Belgian Draft Horses, Vol. 1.
American Yorkshire Record, Vols. 1–4.
American Chester White Record, Vols. 5 and 6 and 8–17.
American Southdown Record, Vols. 1–9.
American Oxford Down Record, Vols. 11–12.
Jersey Herd Register, Vols. 59–78.
American Polled Durham Herd Book, Vol. 5.
American Aberdeen Angus Herd Book, Vol. 22.
Holstein-Friesian Herd Book, Vol. 31.

American Hereford Herd Record, Vols. 37 and 38.
American Guernsey Herd Register, Vol. 12 and 20–26.
American Berkshire Record, Vols. 42–44.
National Duroc Jersey Record, Vol. 44.
American Shorthorn Herd Book, Vols. 79 and 80.
Standard Poland China Record, Vols. 32 and 33.
American Poland China Record, Vol. 62.
National Poland China Record, Vols. 28–33.
Ohio Poland China Record, Vols. 21–23 and 25–27.
American Saddle Horse Register, Vol. 5.
American Shropshire Sheep Record, Vol. 23.
American Hampshire Record, Vol. 6.
American Tamworth Record, Vols. 1–3.

Toggenburg milch goats owned by Winthrop Howlands, California, used to determine the relative cost of milk from goats and cows.

Loan.—Mr. Winthrop Howland, breeder of Toggenburg milch goats, Redlands, Cal., has loaned us four does, two of which are pure-bred Toggenburgs and two grades, to be used in experimental work to determine the relative cost of milk production by goats and cows.

This division has loaned to the California Polytechnic School at San Luis Obispo, for a period of one year, a pure-bred Holstein-Friesian bull, Teake Lyons Pontiac Segis, No. 119322, value $350.

For the fiscal year the sales of the division have amounted to the total sum of $16,993.65. Of this amount, $2990.35 has been received for milk and cream, $4756.35 from the sale of dairy animals, $3670.44 from beef animals, $3520.51 from hogs, $445.65 from sheep, $500 from horses, other receipts $1110.35.

During the year the live stock equipment has been increased by the addition of 25 head of Guernsey cattle, four Jerseys, three Ayr-

shires and one Holstein. The Guernseys constituted the herd of Mr. J. H. Mackenzie of Yuba City, and nine were bulls, three of which have been sold. The four Jerseys were yearling heifers from the Meridale herd of Ayer & McKinney, Meredith, New York. The Ayrshires purchased consist of a young bull, a cow and heifer from the herd of J. W. Clise, Redmond, Washington. The one Holstein-Friesian purchased was from the Minnewawa herd of the late Mrs. M. E. Sherman of Fresno.

Guernsey bull calf, University Farm. Winner at Pacific International Live Stock Exposition, Portland, 1913.

Of the members of the dairy herd, 28 have been used in experimental feeding during the year. Complete records of production are now being kept of all cows in milk. During the year eight have been admitted to Advanced Registry on seven-day records, as follows:

	Lbs. Milk	Lbs. Butterfat
Brown Bessie's Gaylark, No. 218062, Jersey	344.9	19.7
Mermaiden's Fern, No. 269301, Jersey	279.9	16.5
University La Polka Lady, No. 217774, Holstein	419.8	14.51
Queen of Hopland, No. 98928, Holstein	404.3	14.11
Korndyke Senorita, No. 194170, Holstein	427.9	14.54
Colantha 4th's Lad Mercedes, No. 118898, Holstein	437.3	15.16
Agnes Colantha, No. 169993, Holstein	303.6	10.35
Roxey Mercedes Queen II, No. 144605, Holstein	339.2	13.54

Two official years' records have been completed. Pietertje Bloom, No. 66816, a Holstein-Friesian cow eleven years old, that made an unofficial yearly record last year of 783 pounds of butter fat, has this year given 21,415 pounds of milk and 654 pounds of butter fat. Her two-year-old daughter, Pietertje Bloom 2d, No. 169995, has made the satisfactory official year's record of 13,501 pounds of milk and 473 pounds of butter fat. Thirteen cows of various pure breeds are now being tested for advanced registry.

Hereford cow, University Farm.

The dairy herd to date consists of the following: Ayrshires, 2 females and 2 males; Guernseys, 17 females and 8 males; Holstein-Friesians, 23 females and 7 males; Jerseys, 19 females and 2 males.

The hog herd has been added to by the purchase of a boar and two sows of the Chester White breed, three Poland Chinas, two Berkshires, three Duroc Jerseys and a large Yorkshire sow. The present breeding herd consists of the following: Berkshires, 24; Duroc Jerseys, 28; Poland Chinas, 29; Chester White, 3; Yorkshires, 1; and Tamworths, 4.

The breeding herd has been seriously weakened by the loss of some of the best brood sows from tuberculosis, apparently due to the feeding of unpasteurized skim milk. In all 14 sows have reacted to

the tuberculin test and of these two have been lost. Thus far there is no indication of disease in pigs sucking the sows at the time they are supposed to have contracted the disease.

The sheep flock has been increased by the purchase of four Cotswolds, three ewes from the flock of Riddell & Sons, and a ram from F. A. Koser of Oregon. The present stock consists of 17 Shropshire ewes, 3 rams and 4 wethers, and 51 lambs of the various breeds. Of the 45 ewes bred this season, 34 raised 51 lambs, a satisfactory increase of 150 per cent.

No additions have been made to the beef cattle herd during the year. The herd now consists of the following: Aberdeen Angus, 8 females and 1 bull; Herefords, 11 females and 2 bulls; Shorthorns, 6 females and no bulls, and 13 steers. In this branch of our work the aim is to produce high-class steers for class work and exhibition, the growing and exhibition of these cattle being considered an important part of our educational work.

CITRICULTURE

BY

J. ELIOT COIT

During the first year after organization the members of the Division of Citriculture have found it necessary to devote most of their energies toward the establishment of courses of instruction at Berkeley. This proved no light task in view of the fact that there existed no text-books, laboratory, nor field equipment. During the year two main courses and four subsidiary courses have been established, the laboratory has been equipped with apparatus and illustrative material, and a good beginning made toward a division herbarium, museum, and library.

At Davis.—A course in citrus and semi-tropical fruits has been established at Davis and a beginning made toward a plantation of semi-tropical fruits. It is the intention to include in the orchard specimens of all varieties of citrus and semi-tropical fruits which the climatic conditions at Davis may permit, the plantation to furnish laboratory and illustrative material for use both at Davis and Berkeley.

A Study of the Factors Influencing Seed Formation in Citrus Fruits.—From the work already done it appears that:

1. In all naturally fertile varieties of orange trees, self-pollination is the rule and cross-pollination is unnecessary. The activity of insects is not needed for such varieties to set fruit.

2. Viable pollen of parthenocarpic varieties is either entirely wanting or is very scarce. It is thus characteristic of parthenocarpic trees to bear fruit without pollination.

3. The time required for complete fertilization after pollination varies with the variety from thirty hours in the Satsuma orange to four weeks in the trifoliate orange.

4. Disintegration of the embryo-sacs sometimes takes place in the Washington Navel and Satsuma oranges. It may occur before the formation of the megaspores, but usually not until afterwards.

5. Some normal embryo-sacs are produced in occasional fruits of both Washington Navel and Satsuma oranges. Thus a few seeds may be produced, provided these particular fruits happen to be pollinated

with viable pollen from fertile varieties. It is the remoteness of the chance of this occurring under ordinary field conditions that accounts for the seedlessness of these fruits.

6. There appears to be nothing in the structure of the flowers of either the Washington Navel or the Satsuma oranges which would interfere in any way with the germination of pollen or normal extension of the pollen tube.

7. Parthenocarpic citrus varieties are probably hybrids between naturally fertile varieties.

The Loquat.—The loquat has been commonly planted as a dooryard tree in California for many years. Most of these trees are seedlings which produce only mediocre fruit. All such trees should be top-worked to improved varieties. In the future only budded trees of good varieties should be planted.

Either quince seedlings or rooted quince cuttings may be used as a stock. The fruits of the new improved varieties are well worthy of extensive cultivation. An active market demand has appeared wherever good fruits were available.

On account of the climatic requirements of the loquat, its culture on a commercial scale is limited to the more frostless belts and localities where winter rains are not too continuous to prevent pollination and setting of fruit.

DAIRY INDUSTRY

BY

L. M. DAVIS

The Educational Butter Scoring Contest is now in its sixth year. During 1913 fifty-one buttermakers in the state took part in the contests. The co-operation of the United States Dairy Division and the official Butter Inspector of the San Francisco market has been greatly appreciated in this work. The rules for 1913 provided for certain prizes and certificates, which were won by the following contestants:

For highest average score during the year—
Victor Baciarini, Suisun, California—Engraved loving cup—Score, 93.75.

For second highest average score during the year—
Peter Peterson, Loleta, California, and Hans L. Beck, Fresno, California, tied—Engraved loving cups—Score, 93.29.

Certificates of merit were also awarded to these contestants. The first entry for 1914, held March 7, resulted in twenty-seven buttermakers participating. The butter judges for this year are Mr. T. J. Harris of San Francisco, Mr. H. S. Baird and the writer, of this division.

The Chief of the Division served as Superintendent of the Dairy Building at the State Fair, the operation of the working creamery being under our direction. Many dairymen take advantage of our willingness to test samples of milk and cream and 269 samples have been tested for butterfat content the past year. Aside from this, seventy-five samples of butter, largely in connection with the Scoring Contest work, have been analyzed for moisture and salt. The division has been called upon by the United States Dairy Division to supervise the inspection of navy butter manufactured in California, and Mr. Douglass is at present engaged in this work, being assigned to Ferndale, California.

The following gifts and loans have been made to the division:

1 Acme De Laval Turbine Separator—De Laval Dairy Supply Co., San Francisco.
1 No. 15 De Laval Hand Separator—De Laval Dairy Supply Co., San Francisco.
1 Disc Continuous Ice-cream Freezer—De Laval Dairy Supply Co., San Francisco.

1 No. 5 Simplex Hand Separator—D. H. Burrell & Co., Little Falls, N. Y. (Baker & Hamilton, Agents, San Francisco).
1 No. 15 U. S. Hand Separator—Vermont Farm Machine Co., Bellows Falls, Vt.
1 No. 6 U. S. Hand Separator—Vermont Farm Machine Co., Bellows Falls, Vt.
1 No. 10 Sharples Turbine Separator—Sharples Separator Co., West Chester, Penn.
1 Jersey Hand Separator—Sharples Separator Co., West Chester, Penn.
1 No. 42 Empire Hand Separator—Empire Cream Separator Co., Bloomfield, N. J.

The business of the University Farm Creamery has lately taken on a steady growth. Milk and cream are now received from eighty-three dairies. The following brief report of the amount of business done will serve to show the volume of the commercial work:

BUTTER FAT RECEIVED FOR THE YEAR ENDING JUNE 30, 1914

July, 1913	10,954.10 lbs.
August, 1913	10,254.52 lbs.
September, 1913	9,138.96 lbs.
October, 1913	8,324.95 lbs.
November, 1913	8,165.03 lbs.
December, 1913	9,330.72 lbs.
January, 1914	9,342.98 lbs.
February, 1914	8,233.37 lbs.
March, 1914	12,968.19 lbs.
April, 1914	15,201.31 lbs.
May, 1914	14,315.19 lbs.
June, 1914	12,531.27 lbs.
Total	128,760.59 lbs.

Gallons of milk bought	29,036
Pounds of butter sold	158,440
Pounds of cheese sold	1,095
Gallons of icecream sold	1,596
Gallons of market milk sold	12,417
Gallons of sweet cream sold	224
Pounds of buttermilk sold	366,892
Gross income	$55,191.48

Dairy Building Repairs.—During the year improvements have been made in the Dairy Building. The stairway was changed and several partitions taken out, thereby increasing the floor space in the creamery, cheese and ice-cream rooms by some seven hundred square feet. This additional space has aided materially in handling the large laboratory classes. Two new combined churns, a small power ice-cream freezer, and three new cheese vats, besides other necessary equipment needed in the conducting of the commercial work, have been purchased during the year.

ENTOMOLOGY

BY

C. W. WOODWORTH

Instruction.—It was thought a year ago that the class work might be diminished as the result of the reorganization of the curriculum of the College of Agriculture. There has been no appreciable change, however, in this respect and the departure of Mr. Bridwell simply increased the work of the other members of the staff, as did also Professor Quayle's absence during the first half-year. I have personally shouldered much of the added work. This has involved no special hardship, but has interfered with research work.

Experiments with insecticides must be conducted in long series with many repetitions. Sixty thousand lots of scale insect eggs were used in the cyanide experiments this season.

Research.—The added work in instruction referred to above has prevented the degree of activity in pursuance of the research work that was desired.

Work at Davis.—This year entomological work was inaugurated at the University Farm by the assignment of Mr. Nickels as resident entomologist. A small building has been erected on a plot of ground assigned to this division and a beginning made in a plantation of bee plants, of insecticide plants, and of silkworm food. The larger portion of the University Apiary was transferred to Davis, and at this point will be accumulated the equipment for the advanced work in apiculture.

Some of the striking results of work of this year and new methods of study worthy of especial attention are presented below:

Silkworms.—That which received the greatest amount of popular appreciation was the inauguration of a study of the problem of the production of silk in California at a cost which will make it a profitable crop. Here, as in most other animal industries, the cost of labor in the production of food or in the care of the animals is the controlling factor determining the profitableness of the undertaking. The way silkworms have been grown for many hundreds of years they have required a much larger number of hours of labor per dollar of gross income than any other important animal product, and there has been no great improvement in this respect from the very earliest times.

As long as this continues we will have to send out many millions of dollars to other countries each year for our silk supply. The investigations undertaken include two efforts to accomplish a cheapening of the process. The pasturing of the worms and the development of a race not dependent on the mulberry. Very little progress was made along the first line, most of the attention being given to a study of the possibility of obtaining other food which can be grown and handled more cheaply than mulberry. As was expected, no new plant was found that could be at once substituted for the natural food of this worm. Most races would accept an occasional meal of a variety of plants. The worms of some races would eat more at a time, eat a greater variety of plants at more frequent intervals than others, and often the better adaptability would be shown in two or in all three respects. No existing race among the very large number tested show sufficient adaptability to give hope of practical results without resorting to the breeding and selection work which has been started.

The actual cause of death in the case of those feeding on poison oak was apparently the toxic quality of the plant. Many silkworms fed freely on this plant and died so quickly and uniformly that there

seemed no other explanation. In all other cases the death resulting from the feeding of other plants than mulberry was apparently due either to starvation (only in the case of very young worms) or to bacteriosis. The infection by bacteria apparently began in the digestive tract and reached the circulation before death ensued. Exactly the same symptoms occur in worms fed exclusively on mulberry when the temperature is too low, when feeding is scant or irregular, or when the food is collected or fed wet. All writers on silk culture have insisted on the necessity of proper temperature and abundant regular feeding with dry leaves to avoid the death of the worms. The problem of a substitute food is, therefore, the development of a race which will accept freely enough of the new food to escape the fatal infection of the alimentary tract.

Spraying vs. Bees.—Ever since spraying has been recommended for the prevention of codling moth injury, there has been more or less insistence upon the filling of the blossom cup of the apple with the spray, and from the first there has been more or less fear expressed as to danger that might follow from the use of the poison. This was early allayed as far as concerns the danger from the consumption of the fruit by carefully conducted tests and experiments, but there remains a very prevalent belief that this practice is fatal to bees and liable to poison people consuming honey if the spray is applied before the blossoms have ceased to produce nectar. For this reason the published directions for spraying almost universally insist on the delay of spraying till the petals have fallen, and in several states the spraying of trees in bloom is a penal offense. It appears that this general fear is not based on experimental data.

We pointed out ten years ago that in the Pajaro Valley the fruit that sets may be wholly that from the first blossoms and that this fruit may be already as large as cherries before the larger part of the blossoms fall and that, to poison the blossom cups of the fruit, the spray would have to be applied before full bloom. It was not necessary at that time to take up the question of the possible danger to bees, since the most satisfactory spraying practice was found not to require early treatment. Recent studies by Mr. Volck of this department have shown the desirability of a spray during blossoming for other purposes and thus raises the question, though there have never been many bees in the valley.

A hive was shipped from the University apiary at Berkeley to Watsonville and placed in a tree in the center of a forty-acre apple orchard just before spraying with an unusually heavy dose of arsenicals as the trees were just coming into full bloom. The hive

was selected by Mr. R. W. Brown, Assistant in Apiculture, and carefully examined by him before and after shipment to Watsonville. He was unable to find any evidence of the poisoning of bees or brood. On the return trip the hive was kept closed until enough dead bees had accumulated for analysis and samples of the pollen and of newly stored honey were also analyzed by Mr. G. P. Gray with negative results in the case of the latter. An amount of arsenic was recovered from the dead bees nearly approaching a toxic dose. All clearly showed that even under the severe conditions of the excessive dose and a locality where practically all the food was from sprayed trees there was no appreciable danger to man from poisoned honey. When the more soluble arsenicals were in use, there is reason to believe that many bees were killed, and even with the insoluble lead or zinc compounds now in use a small percentage evidently die of the poison.

Factors in Longevity.—Mr. J. P. Baumberger, an assistant in the department, has obtained very interesting results in a series of experiments to determine the effect on longevity of a variable temperature as contrasted with one held practically uniform. He found that when insects are exposed to an unusual temperature, either hot or cold, for two days, they live longer in any other temperature than when placed directly in that temperature. It would seem that the physiological disturbance set up by this preliminary treatment results in conditions that require longer to go through than the processes of senescence that finally results in death. It is probable that temperature is only one of the means of so upsetting the physiological balance as to affect longevity and that we have the suggestion of a law that may be of highest significance to students of the action of insecticides in the interpretation of their experimental data.

Cyanide as a Soil Fumigant has been discussed for years, but has never been brought to the stage where a dose or method of procedure could be given. Mr. E. R. Ong, an assistant in this department, has undertaken extensive experiments, under my direction, to determine the action of cyanide gas in the soil. The method devised consists of the use of a series of tubes in the soil through which air could be extracted and the amount of hydrocyanic gas quantitatively determined by the iodine test developed last year in the experiments with scale insect eggs. The plan for obtaining the air samples finally developed consisted of a tube of quarter-inch gas pipe closed below by an iron rivet. After driving the pipe into the ground, a rod was used to drive the rivet a little deeper, thus opening a way for the gas to enter the pipe. Then a glass tube was inserted into the pipe, the lower end nearly touching the rivet. The upper end was pro-

vided with a rubber stopper and a short piece of large tubing connected the end of the gas pipe and the stopper. Air was drawn out of the soil by the use of an aspirator which measured the quantity after it had bubbled through the iodine solution and given up whatever cyanide that may have been present.

In order to drive the pipe straight into the soil and prevent air from the surface going down the outside of the pipe, it was held steady when driving by an apparatus consisting of three pieces of three-quarter inch pipe attached together with a four-way tee holding the three pipes 90 degrees apart. The operator stands on two of these and the quarter-inch pipe is inserted in the third, which stands vertical. The style of hammer used for soil tubes is employed for driving. For removing, a heavy wire hook is caught into a quarter-inch hole previously drilled through the pipe about an inch below the end. A block and tackle arrangement is used to lift the pipe. This is supported by a pipe attached to the apparatus used as a guide for driving.

The results obtained were positive and definite. Where the cyanide gas was pumped into the soil within a foot of the sampling tube, only a very small fraction of 1 per cent was recovered. The soil evidently filtered out the gas, either by absorbing or decomposing it. To determine the capacity of the soil in terms of cyanide loss, calcium chloride tubes were then employed holding 50 cc. of soil, and gas of known strength pumped through and it was found that before any considerable quantity of cyanide could pass, the soil had taken nearly its full capacity, which was found to vary from .03–.012 grams per litre, or 122–440 pounds of sodium cyanide per acre foot.

While this amount makes the cost prohibitive for large use, it is well within the possibilities for soil fumigation of small areas, and indeed is only a little more expensive than carbon bisulphid in clayey soils, and much cheaper in sandy soil and in any soil if the fertilizer value of the nitrogen in the material is deducted.

The dose will have to be regulated by the character of the soil, since no results will be produced until after the soil has received the full amount which it can absorb or decompose. The amount to be effective after this saturation point has been reached is very small and it remains to be seen whether this can be so regulated as to be safe on plant tissue.

Another possible outcome of these experiments may be that in cyanide gas may be found a very significant index of clay colloids in soil, since there was such a decided difference in favor of clay soils.

New methods of studying the action of cyanide gas on scale insect eggs were employed this year with very satisfactory results. There is a very short season when work can be done, but the new methods have enabled us to obtain data on about thirty thousand layings. Each laying averaging perhaps five hundred eggs was divided into two lots, one of which was kept as a check and the other treated with cyanide gas.

Data were secured on the following points:

1. Susceptibility of five different species of scale insects.
2. Differences due to locality—eight widely separated localities covering over half the length and width of the State.
3. Differences due to age—continuous collecting in the same locality throughout the egg period.
4. Differences due to preliminary cooling.
5. Differences due to exposure to preliminary degrees of humidity.
6. Rate of gas diffusion.
7. Difference in production of gas.

The most emphasis was given to the new line of investigation concerning the effect on the toxicity of cyanide gas resulting from a preliminary exposure to different degrees of humidity.

The method adopted for securing the varying humidities was by the use of mixtures of sulphuric acid and water in a dessicator; the following densities were selected, giving approximately the humidity indicated:

Per cent	Density	Per cent	Density
0	1.840	50	1.334
10	1.604	60	1.273
20	1.530	70	1.206
30	1.470	80	1.130
40	1.400	90	1.070

The eggs we exposed for different lengths of time up to two days in these dessicators and then one lot from each was given a treatment for a certain time in a series of strengths of gas, the corresponding check lots containing eggs from each of the same scales being taken from the dessicators at the same time, but not given the cyanide treatment. Usually twelve hundred lots were run in the dessicators at one time, of which six hundred are subsequently treated in cyanide in six different time intervals and ten dilutions of the gas. One lot in each set of ten that have the same strength of gas and length of exposure comes from each of the dessicators; thus every lot has a different treatment.

The practical results from this whole series will be the answering of the question whether the dose used in fumigation should be graduated according to the degree of humidity preceding the treatment, which is subject to a very wide range. Thus far fumigators believe that extreme weather conditions of any kind at the time of fumigating are liable to affect results, though in practice they do not usually stop unless the wind is strong enough to make the handling of the tents uncomfortable, or the accumulation of moisture makes the tents too heavy to handle. For theoretical reasons it seems that the condition of the preceding day or two might require a change of dose to secure uniform results, and these experiments should give a definite and final answer.

The method of handling and keeping records on such a large number of experiments required the development of a system which may be of interest to other investigators.

The best container for such material as scale insect eggs is the common gelatin capsule. We use size 0, ten of which lay side by side and occupy just three inches in width. These are assembled in brass staining trays and a three-inch piece of lantern slide binding tape is attached to the covers. After the gum on the tape is dry, the longer inner parts of the capsules are removed and the tapes with their attached rows of covers are clipped at one end to identify them and arranged in pairs in pasteboard trays $3\frac{1}{2} \times 6\frac{1}{4} \times \frac{1}{2}$ inch, holding just twenty strips. These are then stocked with eggs by taking one by one the inner portions of the capsule and using it to pry off and receive a scale insect with its eggs. This is then jarred till the eggs are all out from beneath the body and the insect is then dexterously poured out and about half of the eggs are then emptied into a second container. The two are then placed adjacent to each other, mouth up, in the corresponding covers on two tapes in the tray. When the two hundred capsules are thus filled, they are ready for treatment and constitute one set.

Treatment with cyanide gas is effected by suspending the strip of ten capsules near the top of a tumbler, using the "gem" paper fasteners, bending one end out as a hook and forcing the remaining loop sidewise so that it will hold steadily against the edge of the glass. In the glass a solution of hydrocyanic acid gas in water maintains a density of gas in the air above, varying with the strength of the solution and the temperature. The cover consists of a piece of thin paraffined paper held on by a rubber band.

A stock solution of hydrocyanic acid is made up fresh each day and from this a series of dilutions are made for each set.

The routine is as follows: A crystallizing dish of a size that will just hold a circle of nine whisky glasses is chosen and the glasses are filled with water. Two glasses with the stock solution are placed in the center, a small lipped beaker completes the outfit. The capsules containing the eggs to be tested are in place in ten tumblers. One person pours one glass of stock solution into the beaker and then pours it carefully into the first tumbler, being careful not to spatter the capsules. Another immediately places on the paper covers. The first person then pours the other glass of stock solution into the beaker and one of the glasses of water and after filling the glass with the mixture pours the rest into the second tumbler. The glass containing the mixture is then poured again into the beaker, together with another glass of water and the process continues as before. This routine is followed until the ten glasses contain each a whisky glass of solution containing percentages of hydrocyanic acid varying from the strength of the stock solution at one end to one five hundred and twelfth as much at the other.

Each set of checks is kept outside the tumbler containing the specimens being treated. The capsules are closed, usually before the treatment is started in the case of the checks, and after adequate airing for those coming from the treatment chamber. Finally all are attached to three by five cards by rubber bands, the checks on one side and the treated specimens on the corresponding position on the other side. Two cards are required to hold the two hundred capsules of a set. The record card is held between the two capsule covered cards also by rubber bands. Each record card contains two hundred spaces on which to record the hatch. Our experience has shown that nearly 100 per cent of the checks hatch, but there are occasional exceptions, making it desirable to have checks in all cases. The capsules can be examined under a binocular without removing them from the cards.

These experiments conclude a series extending over three years which will now be ready to put in form for publication.

Parasitology.—Sanitary surveys, mosquito surveys, and fly surveys have been made in Bay Point, Redwood City, Coronado City, and Atherton. Active control work has been conducted in various localities, covering periods of several days to several months. Ordinarily graduates are employed by the communities or individuals concerned. Special lectures on rural hygiene and sanitation have been given in many communities. Ordinarily the community is visited early enough in the day to permit of a careful inspection of the locality concerned. The members of the board of health, town officials, and committees are met in the afternoon and are given

specific advice. The evening is devoted to a public meeting. The organization in charge does the necessary advertising, furnishes the hall and lantern if an evening lecture; otherwise enlarged photographs are used.

Insecticide Work.—Because of the change in the insecticide law the work of the laboratory was changed this year by the elimination of the greater part of the routine analysis and the concentration of the attention upon important problems, the most important of which has been the completion of the study of Phenolic insecticides and fungicides, a class of substances rarely recommended by entomologists and very extensively sold as proprietary articles.

A beginning was made in the revision of the methods of examination of insect powders, another group of preparations having large sale and without recognized standards. The number of routine analyses for the year was about two hundred, of which about 15 per cent were users' samples and a considerable number were those submitted by Horticultural Commissioners. This shows a remarkable increase in the popular recognition and use of the laboratory by growers.

A new policy was also adopted this year of deputizing the County Horticultural Commissioners, thus securing their co-operation in the enforcement of the law. The following commissioners have been appointed for this work the present year:

County	Name	Address
Alameda	Fred Suelberger	418 14th st., Oakland.
Butte	Earl Mills	Oroville.
Colusa	L. R. Boedefeld	Colusa.
Eldorado	J. E. Hassler	Placerville.
Fresno	F. C. Schell	Fresno.
Glenn	Carl J. Ley	Willows.
Humboldt	G. B. Weatherby	Eureka.
Imperial	F. W. Waite	El Centro.
Kern	K. S. Knowlton	Bakersfield.
Kings	B. V. Sharp	Hanford.
Lake	G. A. Lyon	Lakeport.
Los Angeles	Wm. Wood	Hall of Records, Los Angeles.
Madera	George Marchbank	Madera.
Merced	N. H. Wilson	Merced.
Monterey	J. B. Hickman	Aromas.
Napa	A. D. Butler	Napa.
Nevada	D. T. Norton	Grass Valley.
Orange	Roy K. Bishop	Court House, Santa Ana.
Placer	H. H. Bowman	Bowman.
Riverside	R. P. Cundiff	Riverside.
Sacramento	F. R. M. Bloomer	Sacramento.

County	Name	Address
San Benito	L. H. Day	Hollister.
San Bernardino	S. A. Pease	Court, House San Bernardino.
San Diego	H. H. Weinland	Court House, San Diego.
San Joaquin	W. Garden	Rm. 10, Court House, Stockton.
Santa Barbara	C. W. Beers	Box 441, Santa Barbara.
Santa Clara	E. L. Morris	Hall of Records, San Jose.
Shasta	George A. Lamiman	Redding.
Siskiyou	J. F. Wetzel	Yreka.
Solano	C. R. McBride	Vacaville.
Sonoma	A. R. Galloway	Santa Rosa.
Stanislaus	A. L. Rutherford	Modesto.
Sutter	H. P. Stabler	Yuba City.
Tehama	Chas. B. Weeks	Red Bluff.
Ventura	R. S. Vaile	Santa Paula.
Yolo	G. H. Hecke	Woodland.

FARM MECHANICS

BY

F. L. PETERSON

The large number of students enrolled in the courses in Farm Mechanics demanded the entire attention of the staff.

The division assisted in two traction engine demonstrations, one at Fresno and the other at West Sacramento, California. These demonstrations were conducted by "Orchard and Farm," but the technical questions were handled by this division. While this demonstration was staged by private enterprise, this division lent its assistance willingly.

LOANS TO THE DIVISION

Baker & Hamilton—
- Mowing machine, Buckeye, 5-foot cut, gear drive.
- Sulky plow, P. & O., Success, 14-inch share.
- Walking plow, P. & O., Scotch Clipper, 14-in.

California Engineering and Supply Co.—
- Gas engine, Ziegler Schryer, 4 H.P.
- Centrifugal pump, type B with hand primer.

Fairbanks Morse & Co.—
- Gas engine, horizontal, 10 H.P.
- Gas engine, vertical, 4 H.P.
- Stroke pump.
- Electric motor, 10 H.P. and starter.

Holt Manufacturing Co.—
- Gas tractor, Caterpillar, 65 H.P., No. 2074.
- Two Davis disc gang plows, 6 discs each, No. 294, 295.

International Harvester Co.—
- Gas tractor, wheel type, 25 H.P.

Pacific Implement Co.—
- Walking plow, 12-in., South Bend.
- Walking plow, 12-in., South Bend, black land.
- Walking plow, 10-in., South Bend, vineyard.

DONATIONS

John Deere Plow Co.—
- Gas engine, 2 H.P., Root & Vandervoort.
- Sulky plow, 12-in., Stag.
- Alfalfa cultivator.
- Manure spreader.

The new oak-like walnut in center; on either side a typical California black walnut seedling; all from *same cluster* of normal nuts from a California black walnut tree. Apparently oak does not enter into the origin of this new form.

GENETICS

BY

E. B. BABCOCK

Instruction.—The primary purpose in organizing this division was to provide instruction in the principles of breeding for sophomores in the College of Agriculture. Conforming to this plan, the writer's first attention has been given to the course for sophomores, with the result that a certain measure of success has been achieved.

During the past year eleven advanced undergraduate and three graduate students have worked on special topics in genetics and submitted reports or theses. The following topics among others have been studied: "Corn, Its Culture and Improvement," "Carnation Breeding," "Wheat Breeding in America," "Seed Selection and Breeding," "Pollen Germination in the Walnut," "Chromosome Counts for Certain Walnuts."

Research.—The policy of this division is to have comparatively few *projects* and numerous minor investigations going forward.

Study of a New Variety of California Black Walnut.—Since 1907 the investigation of a new form *Juglans californica* Watson has been under way for the purpose of discovering the nature and origin of this form. The variety has been described and various hypotheses concerning its origin discussed in University of California Publications in Agricultural Sciences, Vol. 2, No. 1. Recent work on this problem has led to the following conclusions:

1. The belief, which has been generally held, that the new form *J. californica* var. *quercina* originated through hybridization between walnut and oak is not supported by our observations and results.

2. There is no evidence that hybridization with other species of walnut or cross pollination with other trees of the same species causes the appearance of the new form.

3. Abnormal, late appearing flowers and fruits occur rather frequently on the wild black walnuts, but they very seldom produce *quercina* seedlings and certainly are not the cause of the origin of the new variety.

4. The evidence that seedlings of the new variety do come from certain normal nuts is conclusive since a tree has been located that

annually produces such seedlings among its normal progeny. What internal change or changes take place in the growth of the flowers or development of the young fruits that determine the appearance of *quercina* instead of *californica* seedlings remains to be discovered. This must be attempted by the further testing of individual nuts from the above mentioned tree and the microscopical examination of flowers in all stages.

Peach Breeding.—This report has to do with one phase of a three-fold project, viz., the securing of improved fruits through cross breeding. Being impressed with the vigor, productivity and certain valuable fruit characters of the Chinese Saucer or Peen-to peach in Southern California, Mr. C. O. Smith and the writer made crosses in 1909 and 1910 between that species of Amygdalus and the following varieties of common peach: Strawberry, Frances, Florida Gem, Hall's Yellow, Sugar, Elberta, Rogers, Red Ceylon, Honey, Wheatland Cling, Japan Dwarf Blood, Carpenter. The original hybrid seedlings are on the grounds of the Whittier Plant Disease Laboratory. Buds from them are growing at Berkeley, where we also have second generation seedlings from the following crosses: Peen-to by Hall's Yellow and Elberta by Peen-to. These will be tested at Berkeley and, if promising, eventually at various other localities.

Through the courtesy of the Bureau of Plant Industry of the U. S. Department of Agriculture, the following new introductions have been received from the Chico Plant Introduction Gardens and are growing at Berkeley:

No. 353.	Mexican Peach (1)	S. P. I. 32380
No. 354.	Bolivian Freestone Peach (2)	S. P. I. 36127
No. 356.	Sutter Creek Peach (2)	S. P. I. 36125
No. 357.	Crosby Nectarine (2)	S. P. I. 34688
No. 358.	Freitcheng Peach (2)	S. P. I. 21989
No. 359.	Prunus davidiana (50)	S. P. I. 34515
No. 364.	Maxwell Nectarine (2)	S. P. I. 34684

From Arnold Arboretum bud wood of *Prunus mira* has been received and propagated.

Potato Improvement.—The collection of varieties under test in 1913 and the bulk of selected stock on hand was transferred to the Division of Vegetable Gardening at the University Farm in March, 1914. There were retained at Berkeley certain tuber-unit selections made in 1913 for the purpose of studying correlation between tuber characters, especially yield, and other vegetative characters, particularly height of plant and color and texture of leaves.

Tomato Hybrids.—Second generation plants have been grown from certain crosses made in 1911. The results generally agree with those secured by Gilbert at Cornell University. Certain of the F2 plants were selected for testing in F3 and the seedlings are now in the field.

Maize Hybrids.—A number of varieties including all the principal types of maize were grown on the campus in 1913. Many crosses were made and some of these will be grown for the study of inheritance.

Hybrid Lilies.—These are the only bulbous plants worked with thus far that give much promise of success. Some second generation plants are developing and the seed from last summer's crosses is sown.

Hunnemannia (Mexican Poppy).—Selection for tendency to produce double flowers was begun in 1913, and crosses were made between certain promising plants.

Vetches.—Several species of known value as cover crops are being grown for the purpose of producing hybrids in order to secure a form of greater value than any now under cultivation.

Flax.—A number of distinct species are being grown as material for the study of the physiological aspects of inheritance.

IRRIGATION INVESTIGATIONS

BY

FRANK ADAMS*

The work of this division has continued under the co-operative arrangement with the Office of Experiment Stations of the United States Department of Agriculture. Since 1903 the Office of Experiment Stations has maintained co-operative relations in irrigation investigations with the State Board of Examiners or with the State Department of Engineering, and throughout this period it has maintained its California office with this department at Berkeley. Since the establishment of the University Farm in 1907, a portion of the co-operative work carried on by the Office of Experiment Stations and the state boards has been carried on there, the University furnishing the land and labor and seed needed in the experiments and investigations and taking in return the produce raised. Since 1912 this division has been bearing approximately one-half of the total expense incurred in this irrigation work and has also paid sufficient of the salary of the irrigation engineer locally in charge at Davis to cover the time devoted by him to irrigation instruction there. During the past fiscal year this division has also contributed to the expense of duty of water investigations conducted by the Office of Experiment Stations and the State Department of Engineering in Sacramento Valley away from Davis and in Imperial Valley. Thus the irrigation investigations and experiments and the irrigation instruction at the University Farm to which this division has given support form an integral part of the co-operative irrigation work of the Office of Experiment Stations and the State Department of Engineering. The work reported by this division therefore includes a part of the work carried on under the joint auspices of the Office of Experiment Stations and the State Department of Engineering, our co-operative arrangement with the Office of Experiment Stations making it desirable that the California representative of that office shall also be the representative of this division in this work.

* Irrigation Manager, Office of Experiment Stations, U. S. Dept. of Agriculture.

Irrigation Investigations at Davis.—As during several previous years, these have embraced the following lines of work: Duty of water investigations in connection with rotation experiments with wheat, oats, barley, Indian and Egyptian corn, sugar beets, potatoes, and alfalfa; methods of applying water to these crops; tank experiments for determining the water requirements of crops; irrigation of rice; the care and development of a small irrigated orchard and a small irrigated vineyard; and the installation and testing of irrigation measuring devices.

Two crops per season with irrigation. After harvesting a crop of grain on this land in May, 1913, the land was irrigated and seeded to Indian corn. In August and September eight to fifteen tons of green ensilage per acre were taken off, depending on the amount of water applied.

It is, of course, not possible in a single year to obtain conclusive duty of water data. Results up to and including the season of 1912 have been published in the United States Department of Agriculture Bulletin 10. Figures obtained in the experiments in 1913 continue to show that up to a certain point crop yields increase quite consistently with increasing amounts of irrigation water, after which in some cases they decrease. For instance, in one of the experiments with wheat the yield increased from 2.17 bushels with no irrigation to 30 bushels with 10 acre-inches of irrigation water per acre, decreasing then to 20.6 bushels with 15 acre-inches of water. This is a condition that has frequently been paralleled in other experiments,

showing that farmers should give more and more attention to careful and economical irrigation. Just how carefully it is desirable to use water is also being indicated by the numerous soil-moisture determinations that are being made before and after irrigations. These determinations show that a large part of the water applied even under what are generally considered good methods of practice percolates below the zone of observation, which except with alfalfa, is

Field laboratory of standard water measuring devices at the University Farm. It is intended for testing of these devices, for demonstration, and for use by students in irrigation at Davis. All of the standard devices in general use in California for measuring deliveries of irrigation water as well as several other kinds are included in the installation.

usually the chief zone of root growth. In one field under observation, on which excessive quantities of water were applied by the owner of the tract, soil moisture determinations indicated that one-third of the water applied would have given equally profitable returns. The excessive use of water on this tract was primarily due to faulty methods of application, which the experiments at Davis are helping to correct. In all, 3900 soil moisture determinations for the irrigation plat on the University Farm were made in 1913 and about an equal number are being made in 1914.

The work with measuring devices at Davis has been to complete an installation of standard devices for measuring the delivery of water to irrigators. In addition to a reservoir holding about one-quarter acre-foot, the installation, which is known as the Davis field laboratory of irrigation measuring devices, includes a standardizing box through which all of the water delivered to the measuring device is actually measured according to standard methods, a small concrete-lined canal, a short underground pipe system, and thirteen measuring devices for water delivery (p. 126). After this laboratory was completed to the present point, a series of careful tests was made of each of the devices in order to determine their relative accuracy. Since the installation of these devices, several individuals or companies who have developed special devices have made arrangements to install them in the laboratory at their own expense, and the same privilege will be granted to others. Thus it is expected ultimately to have installed on the University Farm examples of all of the more important irrigation measuring devices common to western field practice. An illustrated bulletin describing the devices installed in this laboratory and giving the results of the tests that have been made of them is now in course of publication by this department.

Complete cost data have always been kept in connection with the field irrigation experiments conducted on the irrigation plat. In 1913 the total cost for labor, cultivation, seed, irrigation, and harvesting was $392.01 and the total value, at current market rates, of the produce grown was $599.17, leaving a net profit for the farming operations of $207.16.

General Field Investigations.—Not counting investigations wholly paid for by the Office of Experiment Stations and the State Engineering Department, these have included studies of the duty of water for alfalfa on about fifty farms in 1913 and on forty-six farms in 1914; a study of duty of water for alfalfa on seven farms in Imperial Valley; and a study of irrigation, soil, and general crop conditions in the Sierra foothill belt. A bulletin giving the results of the study and outlining conditions in this important region is about ready for publication.

LANDSCAPE GARDENING AND FLORICULTURE

BY

J. W. GREGG

During the period of ten months just passed, the work of perfecting the organization and collecting materials and equipment for present as well as future instructional work has continued. As a result, the division is especially well prepared to greatly strengthen its various courses during the next collegiate year and in addition has been able to offer a number of new courses. In addition to the regular instructional work, much time has been spent, especially by Professor Stevens, assisted by Miss Jones, in collecting and tabulating valuable data concerning "plant materials," their nomenclature, value, and adaptability for use in landscape design in the varying soil and climatic conditions of California. Such data will prove of inestimable value for future instructional work and will, in addition, form the basis for bulletins and circulars as fast as the data may be completed.

Besides correspondence, a large amount of time has been spent in furnishing information in the form of reports, plans, specifications, and planting lists. Calls for such service have come from city and country schools, owners of small suburban and country homes, and cities and towns having park and playground problems to solve. Such problems, as far as practicable, have been handled by students majoring with this division, but under the direct supervision of members of the staff. Such service has been rendered only when it was perfectly clear that the work would not be in competition with the profession, and would, on the other hand, not be commercialized.

Requests for landscape advice in the form of plans for the development of rural school grounds, town parks, and playgrounds, have been so numerous that many have had to be refused or postponed until next year on account of lack of time to properly furnish such data.

During the year the division has been called upon by the University for assistance in carrying out the plans for foresting the hill-country east of the campus, and in view of the fact that Professor Stevens was closely associated with that work before coming to the

College of Agriculture, he has continued in such advisory capacity and has given a considerable amount of his time and thought to these planting problems, with the result that a most excellent season's work has been accomplished.

Planting plans for the Hearst Mining Building have also been prepared by this division, have been accepted by the President of the University, and the practical work of carrying them out is nearly completed. The above mentioned work claimed a considerable amount of Professor Stevens' time, both in study and supervision. As a result of this service already rendered the University the division has been instructed to prepare planting plans for the Doe Library, California Hall, Boalt Hall, and Agriculture Hall.

The landscape work in both permanent and temporary form has been continued this spring at the University Farm School at Davis, according to plans prepared during the winter; such plans calling for the use of about two carloads of stock, some of which has been purchased and some has come from the nurseries here at the University. The planting has progressed most satisfactorily with the result that Dormitories No. 1 and No. 2, both front and rear, and the Office Building, have been planted with permanent stock, and, in addition, plantings have been made around other buildings and groups of trees and shrubs located to produce future shade and a frame for the main portion of the campus. This work has also taken a considerable amount of time both here in the draughting-room and at Davis in consultation and supervision. This division has also furnished stock and labor for such planting at Davis to the amount of nearly $400.00.

NUTRITION

BY

M. E. JAFFA

The Nutrition Division has co-operated with the Animal Industry Division at Davis to the extent of carrying out chemical analyses of 80 samples of feeds. These comprised alfalfa, beet pulp, corn and oat silage, alfalfa and grain hays, and a number of grains, oil cake meals and dried beet pulps, as per accompanying tabulations. The samples were taken in connection with experiments conducted at Gilroy, Dos Palos, Davis, San Leandro, California, and Lovelock, Nevada.

Thirteen samples of chick feeds have been analyzed in co-operation with the Poultry Division at Davis.

The Nutrition Division has had charge of the chemical work involved in the inspection and control of certified milk by the San Francisco County and Alameda County Medical Milk commissions. This work involved chemical analyses of 279 samples of milk, cream and skim milk, taken by members of the Division of Veterinary Science. On the whole, the dairies supplying milk made a satisfactory showing, only one dairy being unable to reach the required standard. The certification for this dairy was withdrawn in July, 1913. Certified milk must contain not less than 3.5 per cent fat and a minimum of 8.5 per cent of solids not fat.

In reply to requests sent in by various companies and citizens of the state and in co-operation with the California State Dairy Bureau, a number of chemical examinations have been made. These include:

Milk	63 samples
Cream	12 samples
Butter	12 samples
Cheese	2 samples
Human milk	8 samples
Goat's milk	7 samples
Water	16 samples
Poultry and stock feeds	38 samples
Dates	1 sample
Avocado	1 sample
Spineless cactus	1 sample

Olive oil	1 sample
Flour	32 samples
Grape juice	1 sample
Gluten bread	6 samples

Also several toxicological examinations have been made of milk, breakfast food, sorghum, poultry and hog.

A Study of the Methods for the Determining of Sulphur Dioxide in Dried Fruits.—The experimental work of this project involved an investigation of the following points:

1. Precautions against extraneous sulphur.
2. Amount of sample to be used.
3. Amount of distillate.
4. Number of distillations necessary.
5. Number of absorption jars.
6. Nature of the oxidizer.
7. Quality of the carbon dioxide.
8. Amounts of other reagents.

A review of the literature on the subject shows several methods, most of which agree upon but one point—distillation. Many combinations of amounts of fruit, reagents and methods of operation are found.

Leach (Food Inspection and Analysis, 1st edition, pages 675–676) outlines a method for sulphur dioxide determination. He states that it is not necessary to use an absorber or an oxidizer for the sulphur dioxide, and suggests water as a means of receiving the distillate.

U. S. Department of Agriculture, Bureau of Chemistry, Bulletin No. 107, gives only the method for wine, which is outlined briefly as follows:

"Distill a 100. gms. in a current of carbon dioxide after the addition of about 5 cc. 20 per cent Glacial Phosphoric acid until about 50 cc. have passed over. Collect the distillate in a N/10 iodin solution.—Twenty-five cc. of N/10 iodin solution may be employed, diluted with water to give desired volume.—Determine the excess iodin with standard Hypo."

U. S. Department of Agriculture, Bureau of Chemistry, Bulletin No. 137, page 115, gives the following method:

"Distill from 20 to 100 gms. of the sample in a current of carbon dioxide after the addition of about 5 cc. of a 20 per cent solution of Glacial Phosphoric until 150 cc. have passed over. Collect the distillate in about a 100 cc. of nearly saturated bromine water. Allow the end of the condenser to dip below the surface of the liquid in the

receiver.—When the distillate is finished, boil off the excess of bromine, dilute the solution to 250 cc., add 5 cc. hydrochloric acid (1–3), heat to boiling and precipitate with a 10 per cent solution of barium chloride. Boil for a few minutes, allow to stand over night in a warm place, filter on weighed Gooch crucible, wash with hot water, ignite at a dull red heat and weigh as barium sulphate."

In starting this work on a method for the determination of sulphur dioxide in dried fruits several problems were faced. The chemical literature on the subject is very inadequate, and none of it gives information sufficient in detail to enable the analyst to obtain correct and duplicate results.

1. *Precautions Against Extraneous Sulphur.*—Numerous attempts to get blank determinations with reagents brought out the following facts:

(*a*) Some samples of potassium bromide contain appreciable amounts of sulfates.

(*b*) Rubber stoppers and tubing must be entirely eliminated from joints where steam, iodine, or bromide pass because the rubber liberates sulfur under these conditions.

(*c*) Sealed glass joints are best and should be used whenever possible. Other joints were satisfactorily made with rolled corks boiled in 20 per cent phosphoric acid solution.

(*d*) Distillates must not be exposed to atmosphere charged with products of gas combustion. Electric heaters, therefore, were used in a hood for evaporations. Distillations were made with gas because the distillates were protected from atmospheric admixture.

(*e*) Attention to the above points permitted us to obtain perfect blank determinations.

2. *Amount of Sample to be Used.*—Should be governed by amount of sulphur dioxide present to the extent at least of being able to obtain satisfactory titrations or precipitates of convenient size.

(*a*) Experimental Data on Peaches and Apricots.—100 gms. fruit were found to cause too much foaming unless inconvenietly large distillation flasks were used. 50 gms. showed same trouble. 16 gms. showed same trouble, but could be used in 1 liter distilling flask if necessary. 8 gms. found to give quite satisfactory results in a 500 cc. distilling flask without the use of a foam preventor. Apricots seem to foam more than other fruits used in following experiments. Since 8 gms. does not give inconveniently large titrations or precipitates, this weight was adopted. This agrees with the unpublished experience of other investigators.

3. *Amount of Distillate.*—Successive distillations were made from same sample by adding water to residue as follows:

(*a*) Experiments with Iodin and Apricots.—8 gm. sample of apricots and 20 cc. 20 per cent phosphoric acid solution and 180 cc. of water in 500 cc. Jena distilling flask with current of carbon dioxide from Kipp generator. Carbon dioxide contained no sulphur, as shown by lead acetate solution in wash bottle interposed between generator and distilling flask. Flask carried cork stopper. Two Drechsel gas absorbers connected by rubber tube—there being not more than three-quarters inch of rubber exposed to action of iodine. For the first distillation the first absorber contained 50 cc. N/100 iodine in potassium iodide, and the second contained 25 cc.; for succeeding distillations 25 cc. N/100 iodine was placed in each absorber.

EXPERIMENTS CARRIED OUT IN DUPLICATES MARKED A AND B

No. of Distillates	Apparatus	Vol. of Distillate	Cc. I. absorbed 1st abs.	Cc. I. absorbed 2nd abs.	mg. SO_2 per kilo. 1st abs.	mg. SO_2 per kilo. 2nd abs.
1st	A	175	13.2	1.02	528	40.8
	B	175	13.1	1.20	524	44.0
2nd	A	150	4.0	.70	160	28.0
	B	150	6.1	1.50	244	60.0
3rd	A	150	5.0	Not	200	.....
	B	150	6.8	appreciable	272	.....
4th	A	150	3.6	Not	144	.....
	B	150	5.2	appreciable	208	.....
5th	A	150	3.5	Not	140	.....
	B	150	6.7	appreciable	268	.....
6th	A	150	2.6	Not	104	.....
	B	150	4.9	appreciable	196	.....
7th	A	150	2.5	.....	100	.....
	B	.....	Flask broke		.....	.....
8th	A	150	3.4	.....	136	.....

These results show one or two things or both, viz.:

(1) A distillate neutral to iodine is not obtained on account of volatile organic matter, or else reduction of sulfate to sulfite in distilling flask.

(2) Iodine is volatilized from absorbers by the current of carbon dioxide. This would be disastrous to volumetric determinations without additional inconvenient absorbers, but of no importance to a gravimetric determination of sulphur.

This is but one of several experiments with similar results.

(*b*) Experiments with Bromine and Apricots.—The distillations with bromine were made primarily to determine the amounts of sulphur dioxide obtained from successive distillations on the same sample and also the relative amounts obtained in the 1st and 2nd absorbers. For the first distillation—the 1st absorber contained 100 cc. bromine in potassium bromide and 10 cc. sodium carbonate; the 2nd absorber 25 cc. bromine and 3 cc. sodium carbonate. For each successive distillation 50 cc. bromine and 5 cc. sodium carbonate and 25 cc. bromine and 3 cc. sodium carbonate in the 1st and 2nd absorbers respectively. 175 cc. distilled over the first time and 150 cc. for each succeeding distillation. Six distillations were made. The experiments were made in duplicate as indicated below:

	1st Distillation		2nd Distillation	
A	1st absorber	2nd absorber	1st absorber	2nd absorber
A	411	41	54	205
B	417	trace	trace	trace

In distillations 3, 4, 5, and 6, the precipitates were so small as to be negligible—also from all but the 1st absorber in apparatus B. It will be noted in the 2nd distillation, apparatus A, that the parts per million are about four times greater in absorber 2 than in absorber 1. Probably this was due to the action of the bromine on the rubber connection, brought in by hot water washings. It was therefore decided to make a glass seal between the absorbers.

	1st Distillation		2nd Distillation		3rd Distillation	
B	1st absorber	2nd absorber	1st absorber	2nd absorber	1st absorber	2nd absorber
A	527	27	154	89	99	78
B	626	44	345	78	89	119

The above results were probably influenced somewhat by a fall of soot in the evaporating hood.

Another experiment was therefore made on part of the same sample, which showed more nearly comparable results.

	1st Distillation		2nd Distillation	
C	1st absorber	2nd absorber	1st absorber	2nd absorber
A	530	none	78	none
B	534	none	154	none

The discrepancy between the second distillation in A and B is here probably due to failure to stop the first distillation at the same degree of dryness.

Too moist residues may retain sulphur dioxid and too dry ones may make sulphur dioxid from the interaction of sulphuric acid and organic matter at a high temperature.

Another set of several distillations were made, which showed very concordant results, but the data were unfortunately lost. Owing to the pressure of fruit processing to which these experiments were preliminary, there has yet been no opportunity for duplicating that data. It will be undertaken within the next week or so after the sulphur squad has disbanded.

The Bromine Method Applied to Syrup.—Several determinations of sulphur dioxide in Karo corn syrup were made where the sulphur dioxide content of the syrup was very high. Using an 8 gm. sample, it was found that even with boiling to a very small volume, it was impossible to get all the sulphur dioxide. However, when an 8 gm. sample was diluted to 100 gms. and a 12.5 gm. sample of this dilution used, a single distillation of 175 cc. carried over all the sulphur dioxide as shown by the folowing results:

	Sulphide dioxide
8 gm. sample of syrup undiluted	13165 parts per million
8 gm. sample of syrup diluted, 12.5 gms.	17727 parts per million

Second distillations showed several hundred parts in the 8 gm. undiluted sample, while the diluted 12.5 gm. sample showed only a trace.

Direct Oxidation Method.—The plan of this method was as follows:

Fifty grams of finely chopped dried fruit placed in a mortar dampened with water and made alkaline with sodium carbonate, macerated to a smooth pulp. Transferred to a 500 cc. graduated flask and made nearly to volume. Allowed to stand over night. Added acid to mark the precipitate pectins, etc. Centrifuged and pipetted off to 100 cc. portions.

The first portion: heated to boiling, acidified with hydrochloric acid and precipitated with barium chloride, allowed to stand, filtered washed and ignited.

The second portion: added bromine to oxidize sulphur dioxide to sulphuric acid, added 5 cc. concentrated hydrochloric acid, boiled off the bromine, allowed to stand, filtered, washed and ignited.

A considerable amount of barium salts other than the sulfate was here precipitated. This material was removed by the usual procedure of purifying the barium sulfate precipitate, viz: after the ignition, all the barium present in a form other than the sulfate will be soluble in hydrochloric acid and may be removed by digestion with dilute hydrochloric acid.

Filtration and ignition then gave a pure barium sulfate precipitate ready for weighing.

The difference between the two precipitates calculated to sulphur dioxide gave the sulphur dioxide present in the fruit.

However, serious difficulties were encountered which as yet we have not been able to meet. These consisted in the details of manipulating the large amounts of gelatinous material yielded by fruit juices upon acidifying. Alcoholic precipitation and centrifuging did not completely remove these difficulties, but they did not appear to be insurmountable if more time were given to this method.

Summary.—Sulphur dioxide determinations in fruits are now being made according to the following method:

1. Side neck 500 cc. distillation flask with a cork stopper.
2. Fruit finely macerated and thoroughly mixed.
3. 8 gm. sample placed in flask.
4. 20 cc. 20 per cent phosphoric acid added.
5. 175 cc. distilled water added to contents of flask.
6. 500 cc. Drechsel absorption jar connected to condenser with as short rubber connection as possible, inlets bent vertically for direct connection with vertical spiral condenser. 100 cc. solution of 20 gm. per litre potassium bromide, saturated with bromine and 10 cc. 10 per cent sodium carbonate solution used in jar for absorbing medium.
7. Sodium bicarbonate used in second 500 cc. Dreschel absorption jar to catch volatile bromine.
8. Current of pure carbon dioxide gas passed through the whole apparatus.
9. Distill with medium flame until about 180 cc. have passed over or until the fruit in the distilling flask is in pasty condition.

Extensive as well as intensive agriculture

10. Transfer distillate to 600 cc. Jena beaker, add 5 cc. concentrated hydrochloric acid, and evaporate to about 5 or 10 cc. on electric hot plate in clean hood.

11. Take up with hot water, transfer to 150 cc. beaker, heat to boiling.

12. Precipitate with few drops of barium chloride.

13. Leave in warm place over night, filter, wash with hot water, burn and weigh.

The method as given thus in detail gives very satisfactory results. Almost perfect blanks are obtainable at will and duplicate and concordant results are the rule, as indicated by the following results:

A	Sulphur dioxide Parts per million	
	Original	Duplicate
Prunes	924	931
Raisins	996	1,044
Nectarines	524	504

The results shown in the following table were obtained from specially prepared samples of processed fruits.

Samples of dried fruit were purchased on the market, which were as nearly uniform as possible. 100 gram portions were weighed into jars, 1 tablespoon of sugar and 200 cc. of water added. The jars were placed in an autoclave and cooked for forty minutes at about 5 lbs. pressure.

Removed and allowed to cool. A definite quantity of glucose-sulphurous acid (prepared by passing sulphur dioxide gas through Karo corn syrup) was weighed into each jar of each lot.

The figures here presented represent the results of separate determinations from individual jars.

s practiced at the University Farm.

		Sulphide Dioxide Parts per million	
		1st jar	2nd jar
Peaches	Lot 1	517	480
	Lot 2	3,353	3,370
Pears	Lot 1	377	462
	Lot 2	2,746	2,808
	Lot 3	9,576	9,555
	Lot 4	277	280
Apricots	Lot 1	4,270	4,342
	Lot 2	3,904	3,836
	Lot 3	2,421	2,407
	Lot 4	9,250	9,271
	Lot 5	359	393
Nectarines	Lot 1	1,767	1,804
	Lot 2	524	503
Prunes	Lot 1	2,770	2,781
	Lot 2	9,076	8,978

This, of course, is no critical check on the method, but illustrates its practical application to the work for which it was prepared. Results on two jars from one lot show no variations greater than may be neglected for the experimental dietetic purpose for which they are intended.

Resumé of Work of State Food and Drug Laboratory.—The data reported represents the period from July 1, 1913 to May 1, 1914. During this time twelve hundred and fifty-eight samples were submitted to the laboratory. Five hundred and twenty-one unofficial samples are included in the number just quoted. These consist in the main of samples submitted by the stewards of the different state institutions in accordance with instructions from the State Board of Control. The purpose of the State Board of Control in asking the co-operation of the laboratory in this matter is to ensure a high standard and quality of foods, drugs, and miscellaneous supplies for the several state institutions. It is of more than passing interest to note that since such inspection and examination has been carried on, there has been an appreciable and material improvement in the quality of the supplies furnished.

Complete reports of the work of the laboratory and full details with reference to the organization charged with the enforcement of the food and drug law, the duties of inspectors, the matter of hearings, etc., is published in the biennial report of the State Board of Health.

PLANT PATHOLOGY

BY
RALPH E. SMITH

"Physiological" Plant Diseases.—The most technical fundamental project of investigation is a systematic study or review of the important "physiological" plant diseases. There has always been in Plant Pathology a sort of "catch-all" for diseases of which the cause was not known and which seemed different in nature from those attributable to thoroughly understood agencies. Twenty-five years ago for instance, fungous diseases were only just getting to be thoroughly understood, and this term was not a specific one. Ten or fifteen years later the knowledge of fungi had advanced sufficiently to make it possible to detect and identify most parasites of this class, while the knowledge of bacterial plant diseases was just coming to the fore. A tendency developed, therefore, to attribute all diseases of unknown cause to bacteria, and bacterial diseases meant at that time almost anything in which the real cause had not been demonstrated. The same definition applies now to the term "physiological" disease, although it should be said that there appears to be a class of specific diseases in which neither bacteria nor fungi are the causal agents. It is undoubtedly true, however, that in the case of some of these troubles, organisms of these groups may yet be detected. Others may represent purely functional or nutritional disturbances, while in still other cases the troubles appear to be infectious and it is therefore to be presumed that some obscure form of parasitism exists. Considerable work has been carried on during the past year upon several of these diseases, particularly the internal brown streak of the potato; the little leaf of the cherry and other trees, exanthema or die back of the olive and other trees, and curly top of the sugar beet. On the potato disease Mr. S. S. Rogers carried on a large field experiment, endeavoring to determine the relation of such factors as time of planting, amount of soil moisture, fertilizers, and time of harvesting to this disease. Nothing of an affirmative nature was learned as to the nature of the disease, but the incorrectness of several previous theories was shown, particularly that of the idea that the disease is caused by a deficiency of soil moisture or potash. Variations in these elements showed no relation to the disease in Mr. Rogers' experiment.

The so-called little leaf is a very serious trouble affecting all sorts of trees in the San Joaquin Valley. It has been present there for

several years, always showing a more or less definite relation to soil moisture conditions. The disease seems to develop along with a hard, dry subsoil, especially if soil moisture is particularly lacking late in the season. On the other hand, it does not appear that this soil condition alone can cause the specific disease. Various theories have been proposed as to the connection of crown gall, nematode root knot and other agencies with this trouble, but none of these has been definitely established. Our work during the past season has cast a very great doubt upon the connection of any of these things with little leaf. With the help of Professor Lipman this division has also shown that the disease is not due to alkali. Much of the work has been of a fundamental nature on the condition of the diseased tissues.

Exanthema of the olive is a disease which has begun to attract considerable attention and alarm. The effect of the disease is a dying back, falling off in production and final death of the trees. This disease appears to be identical with the exanthema or Florida die back of citrus trees and should be studied with the latter in mind. This division is co-operating to some extent with Professor Lipman, since he has already been studying some soil phases in connection with the citrus trouble. In this division a considerable amount of interesting work has been done during the year upon the anatomy and cytology of affected trees and the conditions which accompany the disease. Another case of apparently the same disease is that of a number of acacia trees on the University Farm at Davis. Here, under apparently quite different soil conditions from those in the citrus districts where exanthema occurs, an identically similar disease appears to occur. This case is also being studied in an endeavor to determine the actual cause of the disease, which should show a correlation in these various cases.

Curly Leaf of Sugar Beet.—This is a very serious and peculiar disease, the cause of which is entirely unknown up to the present time. One interesting fact has previously been demonstrated—namely, that the disease is spread by an infection carried in the sting of a minute insect, *Eutettix tenella.* This fact gives the disease particular interest, since a knowledge of the exact nature of the infection which this insect transmits might aid greatly in the understanding of other plant diseases. From the results of studies now going on there is reason to suspect that this is a parasitic trouble of a somewhat peculiar nature.

Olive Knot.—Work on the control of this disease has been continued during the past year, and the investigation is now practically completed. Professor Horne and his students have succeeded in showing

very clearly the nature and mode of development of this trouble and the means by which it can be practically arrested.

Armillaria mellea.—The trouble which is caused by this toadstool fungus spreading underground and attacking the roots of many different kinds of trees is becoming an increasingly serious problem in California. In a great many orchards there are gradually enlarging areas here and there where this parasite is taking out the trees. This problem has been pursued during the year by studying the exact mode by which the fungus spreads from root to root, and by carrying on various experiments for stopping its spread by means of barriers and by treating the soil with carbon bisulphide.

Walnut Blight Control.—Spraying experiments made in 1913 for the control of walnut blight and an accompanying pest, walnut aphis, showed quite encouraging results, so that the work has been repeated on a larger scale during the early spring of 1914. More than fifty acres of large walnut trees were sprayed near Goleta in co-operation with the Bishop Ranch, while a considerable amount of spraying was done in other places more or less as a result of and in co-operation with our work. These efforts to develop practical means of spraying large trees have been notably successful, so that whereas it cost more than one dollar per tree to spray large walnut trees poorly in our work in 1906, it is now possible to spray such trees thoroughly at about one-half of this cost. The results of the spraying, using mainly lime-sulphur, have been decidedly good in regard to aphis and promise well for blight control. This work has been carried on with much energy and efficiency by Mr. Walter H. Nixon, who was temporarily employed for the purpose.

In addition to the spraying work, the chief of this division has given considerable attention to an effort to obtain desirable and more or less blight-free walnut varieties by selection among the very large number of seedling English walnut trees in this state. In this work many groves and trees have been visited and the occasional trees which seemed promising have been propagated by grafting into other trees in various places, so that these new varieties might be thoroughly tested. Scions of several varieties were also imported from Europe by the writer and these are now being tried out. The whole subject of walnut varieties is a very new one in the state, and the writer has kept closely in touch with every development along this line, having now under observation a number of selections which promise very well for the future. Another important phase of the walnut work is that of the extension of the industry into parts of the state where the crop is not commercially grown at present. Much interest in

walnut culture exists in California at the present time and much of the writer's time is consumed in answering inquiries and investigating matters connected with the general development of walnut culture. By a conservative encouragement of the industry in regions where further development seems possible, especially where based upon new varieties or increased knowledge of old ones, the culture of the walnut may be profitably developed.

Among the numerous cases of plant diseases which are continually being brought to the attention of this division there is occasionally one which merits further investigation or which develops into a specific problem. Among those which have received more or less special attention during the year may be mentioned the following:

Bean Rust.—Mr. Rogers did a considerable amount of work during the year in an endeavor to find means for checking a serious rust (*Uromyces appendiculatus*) which attacks the Kentucky Wonder bean in San Diego County and prevents the growing of this valuable crop late in the fall. Treatment both with Bordeaux mixture and finely ground sulphur was tried, but unfortunately neither material gave any appreciable control of the disease.

Pear Canker.—A peculiar disease of the pear tree developed in El Dorado County during the past winter, consisting in the production of large, dead, canker-like spots upon the bark of the young trees. Much uncertainty prevailed at first as to the nature of this trouble, but we have found that it is quite certainly due to a fungus and one which can probably be controlled by spraying at the proper season.

Asparagus Diseases in Imperial County.—The disastrous experience which growers all over the country have had with asparagus rust during the past fifteen years has caused this disease to be greatly dreaded in every new district. Consequently when this crop showed a new trouble in Imperial Valley during the past fall, the growers became greatly alarmed, supposing it to be the much dreaded rust. Investigation, however, showed that it was not rust but a different fungus (*Cercospora asparagi*) which it is hoped will prove to be much less serious than the true rust. The matter is still under observation.

Wood Decay of Orchard Trees.—Almost all of this decay results from infection through unprotected wounds made in pruning or grafting or from breaking of limbs, sunburn and similar sources. Work will be continued to demonstrate more forcibly to the growers the amount of loss which is taking place through this source and the means by which it might be prevented. There is perhaps no disease in the state which causes so much actual loss in the production of trees per acre as this little thought of and entirely unheeded wood decay fungus.

POMOLOGY

BY

BURR B. PRATT

It is generally recognized that provision for cross-pollination is advisable for most deciduous fruits. Investigators working with plums in other states have ascribed a marked degree of self-sterility to many of the Japanese varieties. The Domestica or European plums, however, have been little studied and have been commonly considered in large part self-fertile. Growers in California have attributed a considerable proportion of the failure to set fruit with many varieties of Domesticas to this lack of self-fertility. This group comprises drying prunes and a large part of the shipping plums.

With a view to determining the actual relative importance of this factor in determining the set of Japanese and European plums, a project dealing with plum pollination has been started, the preliminary work of the first year being conducted in the orchards of the University Farm at Davis. This work involved studies on: (1) The percentage of fruit set on some of the leading varieties, where cross-pollination was prevented; (2) the percentage of fruit set under definite crosses; and (3) the percentage of normal set of the same varieties. In addition, data are at hand showing blooming dates for two seasons in this orchard.

The information gained by one season's work is altogether too meagre to warrant the drawing of conclusions. It may be said, however, that the results indicate that many of the popular conceptions regarding these factors in the state may be well founded.

The investigation will extend over a series of years and will be carried to commercial orchards in the leading districts.

The Student orchard project proposes the establishment of plantings showing the life-history of the leading deciduous fruits and nuts from seed to bearing age. The work is primarily designed for laboratory and demonstration purposes in connection with the University and Farm School courses, and will be largely carried out by students under the direction of the instructors in charge.

The plantings will be in rotation form, showing the effects of the leading rootstocks, methods of propagation, planting, heading, and

pruning at varying ages. As the work progresses, a valuable collection of experimental data will be accumulated showing the effects of different methods of handling under the soil and climatic conditions prevailing at Davis.

The first unit of these orchard plantings has been made. The plantings include also leading small fruits as well as nursery material to be used in future plantings.

California has a practical monopoly on the production of the almond. Little definite information of a thoroughly reliable character with regard to the proper handling of this fruit is available. With

Bartlett pear trees in University Farm orchard, Davis. Looking west down the row are apricots, then peaches, plums, and finally almonds at the far end. These trees are all in their sixth year, having been planted in March, 1908. The pears are standard trees, being on pear root.

a view to supplying this information studies in almond culture are under way. Nursery stock is growing which will provide material for an experimental planting designed to furnish data covering a wide range of cultural practice, including the value of different methods of pruning and cost of production.

Almond varieties will be given detailed attention with regard to their characters and commercial value. Records are on file giving important phenological data and type differences as indicated by the proportion of meats to whole nuts.

A study has also been made of the conditions and methods prevailing in leading almond districts.

POULTRY

BY

J. E. DOUGHERTY

Investigation.—A feeding experiment to find the relative values of soy bean meal, meatscrap, buttermilk and O. P. linseed oil meal as high protein feeds for laying hens and the minimum amounts of meat and vegetable proteins that can be fed for best results was started December 1, 1913, and will last one year. The feeding of high protein animal feeds represents one of the most important economic problems the poultryman has to deal with, for such feeds are not only the most expensive feeds required in a poultry ration but the cost of animal protein is steadily increasing. As a result the data of this experiment, showing the relative values of the above vegetable protein feeds as substitutes for a part of the more expensive meat feeds that may most

This educational exhibit was staged at all of the leading poultry shows of the State by the Poultry Division during the fall and winter of 1913–14 and proved a great success.

profitably be fed to fowls, will be of great value to the commercial poultryman.

Another experiment to find the relative effects of different degrees of temperature on the number and quality of chicks hatched in incubators and reared to four weeks of age is now under way.

Serious attention has been paid to the yarding, housing, and equipment best suited to poultry conditions in this state. More and more people are going into the poultry business on small acreage each year and they wish to utilize the land to the fullest and build just as inexpensive houses and equipment as possible which will give successful results. With these ends in view, we are attempting to find (*a*) the best methods of yarding and optimum amount of yard room per fowl under our climatic conditions, (*b*) the most suitable types of houses and equipment. Our aim is to design, prove out, and recommend such buildings and equipment as are low in first cost, simple to construct and easy to operate, yet give the very best results. A trapnest and mash hopper might be mentioned as two pieces of equipment designed by this division which have been eagerly taken up by poultrymen because of their many advantages.

An improved brooder system has been designed to meet a serious need for an intermediate sized brooder of simple construction that will operate successfully on low grade fuel oil. It will soon be tested out under commercial conditions.

Extension.—The division sent a member of the staff with an educational exhibit consisting of models of laying houses, brooders, trapnests, hoppers, etc., feed formulas, egg grading demonstration, bureau of information and a great deal of other material to the following fairs and poultry shows:

State Fair, Sacramento—September 13–20, 1913.
San Jose Poultry Show—October 15–18, 1913.
Willows Poultry Show—November 12–15, 1913.
Oakland Poultry Show—November 25–30, 1913.
Petaluma Poultry Show—December 10–13, 1913.
San Francisco Poultry Show—December 31–January 4, 1914.
Los Angeles Poultry Show—January 7–13, 1914.

This exhibit proved very popular wherever staged. A crowd of people could always be found around the booth from early morning till late at night seeking information.

Gifts

One trapnest—Petaluma Incubator Company.
One mash hopper—Terrell Manufacturing Co., Montesano, Wash.
Trio of Buff Wyandottes—O. S. Hofman, San Jacinto, Cal.
One Houdan cockerel—Mrs. E. F. Reid, San Jose, Cal.
Two settings Silver Spangled Hamburg eggs—W. M. Ross, Glendale, Cal.
One setting Silver Wyandotte eggs—W. M. Ross, Glendale, Cal.
One setting Golden Campine eggs—N. C. Luce, Los Angeles, Cal.
Trio Partridge Wyandottes—C. J. Struby, Concord, Cal.

Loans

One electric incubator—O. S. Hofman, San Jacinto, Cal.

profitably be fed to fowls, will be of great value to the commercial poultryman.

Another experiment to find the relative effects of different degrees of temperature on the number and quality of chicks hatched in incubators and reared to four weeks of age is now under way.

Serious attention has been paid to the yarding, housing, and equipment best suited to poultry conditions in this state. More and more people are going into the poultry business on small acreage each year and they wish to utilize the land to the fullest and build just as inexpensive houses and equipment as possible which will give successful results. With these ends in view, we are attempting to find (*a*) the best methods of yarding and optimum amount of yard room per fowl under our climatic conditions, (*b*) the most suitable types of houses and equipment. Our aim is to design, prove out, and recommend such buildings and equipment as are low in first cost, simple to construct and easy to operate, yet give the very best results. A trapnest and mash hopper might be mentioned as two pieces of equipment designed by this division which have been eagerly taken up by poultrymen because of their many advantages.

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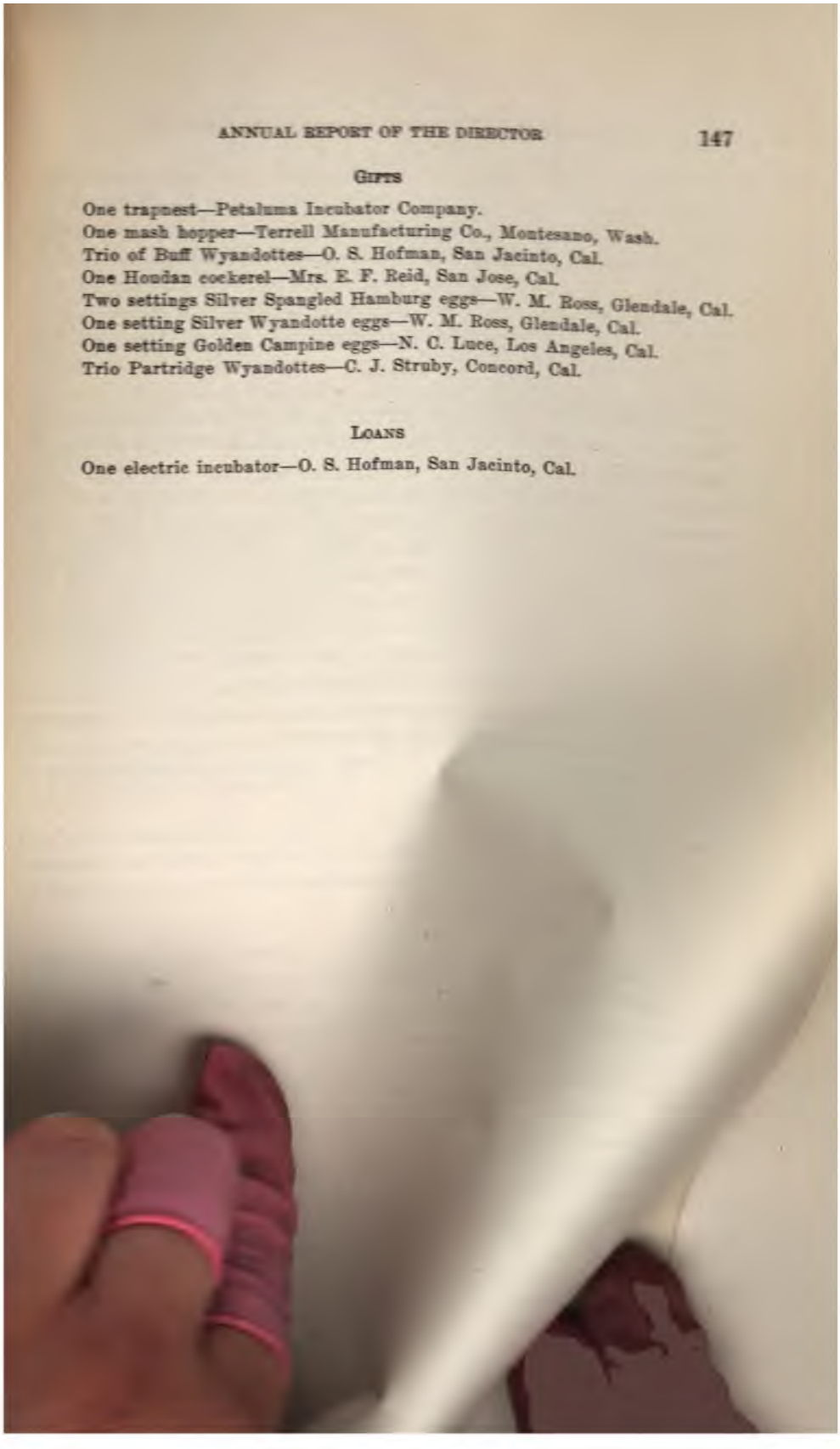


SOIL CHEMISTRY AND BACTERIOLOGY

BY

CHARLES B. LIPMAN

Research Work.—In accordance with the desires of the Director, the major energies of this division are devoted to research work. It has been able to carry out investigations on every one of the twelve projects submitted for approval last summer. In addition to these, considerable work has been done on incidental problems with which the exigencies of research work inevitably confront the investigator.

The net results of these investigations, the details of which are given in our project reports (see pages 25 to 34), have been such as are invested with very great practical and scientific significance. Some of the investigations concerned have already been published or are about to appear in print in the following papers:

1. Antagonism between Anions as Affecting Soil Bacteria, II. Nitrification, published in Centralblatt für Bakteriologie.
2. The Effects of Copper, Zinc, Iron, and Lead Salts on Ammonification and Nitrification in Soils, published in the University of California Publications, Series in Agricultural Sciences.
3. Studies on Ammonification in Soils by Pure Cultures, published in the University of California Publications, Series in Agricultural Sciences.
4. Toxic Inorganic Salts and Acids as Affecting Plant Growth, published in the Botanical Gazette.

Material is also in preparation for the publication of several other papers dealing with the researches of the past year. These researches have made an important contribution to some of the fundamental problems which confront the soil fertility student and the student of agricultural plant physiology.

Routine Soil Examinations and Extension Correspondence.—Two thousand seven hundred and eighty-three (2783) samples of soil were examined during the year ending June 30, 1914, in the various ways necessary for giving information relative to alkali content and plant food content, as well as to the adaptability of soils for crops and as to methods of tillage and fertilization to be adopted.

Twenty-five hundred fifteen (2515) letters have been written by this division during the past twelve months, upward of 90 per cent of

which have dealt with information for the use of farmers, growers, landowners, and prospective settlers. In some cases this information was given on the basis of samples submitted, in others on the basis of information already in our hands from past studies of the Federal Bureau of Soils and this Experiment Station.

Co-operation with Other Divisions.—The Division of Soil Chemistry and Bacteriology has co-operated and is still co-operating with the Division of Soil Technology to the extent of making alkali determinations on the soils of the quarter section of the Kearney Tract, which is being reclaimed by flooding and underdrainage. Six hundred and forty-two (642) samples of soil, taken prior to the flooding of the land, have been examined for all the alkali salts, and in July a similar number of samples from the same spots will be taken and analyzed in an attempt to ascertain how the alkali content of the soil has been affected by flooding and underdrainage.

This division has also co-operated with the Division of Viticulture to the extent of analyzing twelve (12) samples of soil for nitrogen, phosphoric acid, potash, and lime. These samples, six in each case, came respectively from the University Farm at Davis and from the Kearney Tract, where experimental vineyards are at the present time planted. The analyses were carried out for giving information which would serve as a basis, at least in part, of comprehensive fertilizer experiments to be undertaken by the Division of Viticulture.

SOIL TECHNOLOGY

BY

CHARLES F. SHAW

Soil Surveys.—The Division of Soil Technology, in co-operation with the U. S. Bureau of Soils, has carried on soil survey work in the state throughout the year. The soil survey of the Sacramento Valley was started on July 1, 1913, and completed in December. The report was prepared and, with the map, sent to Washington in March. In this survey, an area of about 4,500,000 acres was mapped and over one hundred individual types of soils were found. Some of them were so small in extent that they were not shown on the map, sixty-six types, in thirty-five series, being shown on the completed map.

During the months December to February, the division co-operated in the completion of the survey of Merced County, covering an area of about nine hundred square miles. In February, the soil survey of Southern California was begun, work continuing there until May 1, when the southern work was suspended and the field forces moved north.

Detailed surveys are under way in the Russian River Valley and in the Honey Lake area, and the reconnaissance survey of the bay region was started early in May. It is anticipated that each of these surveys will be completed within the ensuing fiscal year.

Drainage Investigations.—In co-operation with the Office of Experiment Stations of the U. S. Department of Agriculture, the division has drained a quarter section of land on the Kearney Ranch near Fresno. In this area of about 154 acres, 22,030 feet, or about 4.17 miles of tile have been laid. An electrically driven pump has been installed in the sump into which the tile drains and most of the area has been flooded to aid in the removal of alkali. The total cost to date is about $9000. The area that is being reclaimed was some years ago a profitable bearing vineyard, but through high water tables and accumulations of alkali it has been rendered worthless. On another area an experiment has been started to test the efficiency of reclamation by pumping water from a sump without tile drainage. If efficient, this latter method will be much more desirable than the former, as the cost per acre will be reduced to about one-fifth or less.

TOBACCO INVESTIGATIONS

BY

W. A. SETCHELL*

The experiments under grant of Adams' Fund called Project No. 21 have been proceeding as usual during the year 1913–14 in co-operation with the Department of Botany. Data have been accumulated and drawings and photographs have been made. The earlier results of work on this project have been published in volume V of the University of California Publications in Botany. Two papers are in active state of preparation at present, one under the immediate direction of Dr. Goodspeed, who has the assistance of Dr. R. E. Clausen; the other is being prepared by myself. Dr. Goodspeed's report will concern itself with the floral complex, and is an attempt to analyze the various factors entering into the general inheritance and particularly applied to that of the flower. Dr. Goodspeed has used certain horticultural varieties of tobacco for the basis of this work, but certain facts have also been derived from a study of various hybrids of commercial tobaccos as well.

The second series of studies is being made under the direction of Dr. Goodspeed with the help of Mr. Ayres into the behavior of sterile and partially sterile hybrids. A preliminary report has already been made on this subject and Dr. Goodspeed enumerates below some of the details of the work which is going on at present.

The third series of experiments concerns itself with the fixation of hybrids. This work is already in its fifth season and is dealing with the third and fourth hybrid generations between different varieties of the commercial species—namely *Nicotiana Tabacum*. It is estimated that an additional season will bring this work to completion, and it is already in process of preparation for publication.

The fourth series of experiments is concerning itself with the common peasant tobacco of Europe and the behavior of hybrids between the different varieties. The second hybrid generation was studied during the present season and the results have been presented by Mr. R. P. Brandt as a thesis for his Master's degree.

* Department of Botany.

The fifth series of studies concerns itself with various hybrids between certain species of tobacco which either grow wild in California or were cultivated by the Indians of the northwestern region. These studies concern themselves with the transmission of capsular characters as indicated by the number and position of the cells of the capsule. In making the capsule count, I have for the past season employed Mr. R. P. Brandt, who has made the counts and tabulated the results.

As a sixth series of studies there may be included the continued observation of the parents of the various hybrids, together with a general stock of species for future experimentation. Various data have been accumulated in connection with these plants, and statistical tables are being prepared in connection with some of them. New crosses are being constantly attempted and a few are promising to yield interesting results.

Below is tabulated the work which has been going on in the present season:

First Series.—Continuation of the *Nicotiana acuminata* flower size hybrids into the F3 generation. Some 4000 measurements were taken upon hybrids and parents, which, with over 6000 measurements previously taken upon the F1 and F2 generations, constitute as large a mass of data upon the inheritance of a quantitative character in plant hybrids as has been reported upon in genetics literature up to the present time.

Second Series.—Continuation of the studies upon the F1 semisterile hybrids of *N. tabacum* varieties and *N. sylvestris*. Twelve groups of hybrids were grown and a very considerable mass of data which dealt with the general "stimulating effects of heterozygosis" and the extent of variation in F1 was accumulated. The nature of the semisterile character of these hybrids has been taken as the subject for a Ph.D. thesis by one of the graduate students in botany. He conducted numerous experiments in the field in the effort to bring about germination of the hybrid pollen and to cut down the premature falling of the hybrid flowers. His experiments are at present being continued in the conservatory with the same general ends in view.

Production of new hybrids by crossing the parents back upon the F1 N. Tab. x N. syl. hybrids. Two groups of hybrids were raised which exhibited certain points of some theoretical interest. Certain individuals among them may prove to be of horticultural interest. This particular series is to be investigated on a larger scale during the season 1914.

Third Series.—Fixation experiments. During this fifth season plants in the pure line of the third and fourth hybrid generation

representing some four different crosses and their reciprocals were grown in twenty-four families, a total of 1460 plants. Much assistance was obtained from Mr. R. L. Pendleton in taking the necessary measurements. Photographs were also taken of the important types. It is hoped during the coming season to grow an equal number of pure line plants from members of these different families to test the fixation which seems already certain.

Fourth Series.—Seven families of the second hybrid generation of a cross between two varieties of *Nicotiana rustica* and its reciprocal were grown and 602 plants were measured, correlated and reported upon by Mr. R. P. Brandt. His manuscript is deposited in the University Library as a thesis for the degree of Master of Science.

Fifth Series.—Eight families representing in all 707 plants of the third hybrid generation of crosses between *Nicotiana Bigelovii,* a common wild tobacco of the middle Californian region and one much used by the Indians in earlier days, and *Nicotiana multivalvis,* a species known only from Indian cultivation, were grown and allowed to ripen their capsules. The capsules of each plant have been removed, cut open and the number of cells counted for each. The number of capsules range from 10 to 550 per plant. The data thus resulting have already reached a very considerable amount, but the count for the 1913 season is not yet completed. Mr. Brandt is at present working upon it.

Sixth Series.—Somewhere about twenty-three different species, together with a considerable number of different varieties including the parents of hybrids already made and of all other species of which seed could be obtained, have been grown in numbers varying from ten to one hundred. The work on this stock has been of a somewhat miscellaneous character, but two lines of work may be mentioned, carried on particularly under the direction of Dr. Goodspeed:

Statistical analysis of two of the pure lines among the N. Tab. varieties-N. Tab. var. macrophylla and N. Tab. "Maryland." Considerable data as to flower size, height of plant, number and size of leaves, etc. A number of particular points were investigated which have given results of theoretical interest.

Many new crosses were attempted, chiefly species crosses, most of which were unsuccessful. Hybrid seed was in one case produced, and it will be the starting point for a further investigation of the inheritance of flower size.

The work already outlined and partially under way for the present year 1914 may be indicated as follows:

The Work Under the Direction of Dr. Goodspeed.

I.—(A) 13 F2 H38–F3 plants to go into the field this year. The pedigree of 13 F2 H38 is as follows: F1 H38 = 22/07 ♀ × N. sylvestris ♂, made by W. A. Setchell in 1911, was first grown in 1912 and over 800 capsules of unprotected seed were collected at the end of the season. Plants from this common seed flowered in the greenhouse in March, 1913. All were bagged for pure seed and seed from the fertile plants is now being germinated. I hope to see in the field as many as 50 F3 plants from each of 10 numbers.

(B) 13 F1 H38–F2 plants to go into the field this year. 12 F1 H38 were cut back and flowered again in 1913. A number of capsules of unprotected seed were again collected at the end of last season (1913). This seed is being germinated and will give a small number of F2 plants.

The seed of all of the F2 greenhouse plants (see A) was germinated last fall and 65 plants are now in flats in the propagating house. They show a remarkable uniformity for 22/07 leaf shape. In general I am hoping that from these possibly much involved and uncertain pedigrees we may get some groups of uniform F3 or possibly F2 types fixed. Under any circumstances this particular phase of the experiments seems of sufficient interest to be followed through another season (1914).

II.—(A) 13 F1 H121–F2 plants to go into the field this year. H121 = 11 F1 H34 ♀ × 11 N. sylvestris, made by W. A. Setchell in 1911. Eighteen F1 plants flowered in the field during 1913 and contained some unusual and interesting types. The pure seed of all fertile plants of this hybrid is being germinated, and I am anxious to see as large a number of the F2 plants as possible.

(B) 13 F1 H124–F2 plants to go into the field this year. H124 = 12 F1 H38 ♀ × 12 N. sylvestris ♂. I made this cross in the greenhouse in February, 1913. Seventeen F1 plants flowered in the field in 1913 and were as unusual and interesting as those 13 F1 H121 (A above). As many numbers of pure seed as were obtained are being germinated.

(C) H40 ♀ × N. sylvestris—F1 plants to go into the field this year (H40 = 11 110/05 ♀ × 11 N. sylvestris ♂, made by W. A. Setchell in 1911). This cross I made in the greenhouse in November, 1913, on a potted plant transplanted from the field.

In these three groups (II, A, B, C) I am interested to see the progeny of the unusual F1 populations. It cannot fail to be of general interest and there may be further plants of horticultural interest produced which will be more perfectly fertile. In C—the F1 H40 ♀ × N. syl. ♂ cross—I am very much interested to see whether or not with

two "doses" of N. syl. anything of the N. calycina flower type will be lost. It was not as intense in F1 H40 as in 110/05. I want to try to keep breeding the N. syl. against the calycine flower character to see if we cannot eliminate it entirely. This hybrid may also be of interest in connection with III, which follows.

III.—13 78/05 seed from a "calycine" flower. A considerable number of abnormal single and double flowers were formed on all of some 75 plants of 13 78/05. Many such flowers were bagged and artificially self-pollinated and in many cases were sterile. Unprotected abnormal flowers made seed in some cases. One capsule of seed from a protected abnormal flower is being germinated.

This is the least important or interesting group of the three (I, II, III), since there is little possibility that there was any gametic difference between normal and abnormal flowers. These plants may, however, give a few variants with nearly all abnormal flowers, which might then be crossed with the other N. Tab. varieties, especially 68/07, in the effort to reproduce 110/05. These plants will be of interest when it may seem best to describe the occurrence of the abnormal flowers on 13 78/05 and 13 22/07.

VETERINARY SCIENCE

BY

CLARENCE M. HARING

Tuberculosis in Farm Animals

To stop the spread of tuberculosis and reduce the losses therefrom in the State of California is one of the most important and difficult

University of California Experiment Station for the study of tuberculosis in farm animals.

problems which this Agricultural Experiment Station is attempting to solve. As an aid in formulating effective plans for investigation a conference of experts on bovine tuberculosis was held at Berkeley on July 11 and 12, 1913, which was attended by a number of veterinary officials and sanitary experts. Dr. V. A. Moore of the New York State Veterinary College and Dr. M. P. Ravenel of the University of Missouri were the principal speakers. As a result of this conference plans were outlined and embodied in project form. On account of the difficulty in securing a competent experimental pathologist, the laboratory end of the work has been retarded. Nevertheless, a start has been made and the results of this work are summarized in this report.

The Immunization of Calves against Tuberculosis with Bovovaccine.—For several years experiments have been carried on to determine the immunizing value of bovovaccine under California conditions. The preliminary results of this work have been published in veterinary journals from time to time and the results to 1913 were summarized in the last annual report of this station, the conclusion being that von Behring's bovovaccine produces some immunity in calves, but that this does not remain to any appreciable extent after the third year.

It was decided to try the Pearson-Gilliland method of immunization. The vaccine used was the well-known culture Ravenel M reported in the experiments of Pearson, Gilliland and Marshall. Last spring seven calves were vaccinated and have been under observation during the past year. The results are beginning to be apparent. We find this culture to be more virulent than the bovovaccine of von Behring. The vaccinated calves have continued to react to tuberculin, while those we vaccinated with bovovaccine in 1907 ceased to react in eight months.

A reaction to the Intradermal tuberculin test. This test constitutes an important step in the control of bovine tuberculosis. A reaction is indicated by a swelling or thickening of the skin at the point of injection. The most suitable place of injection is at the base of the tail.

Infection experiments are now being undertaken to determine the immunity produced, and the results will probably be obtainable in a few months. The results to date of the immunization experiments do not lead us to believe that bovovaccine or any of the similar so-called vaccines for tuberculosis on the market are of any practical value. Stockmen are advised not to use them until further information is obtained concerning their efficiency.

The Intradermal Test for Detecting Tuberculosis in Cattle and Swine.—Under this project some conclusive results have been obtained which are published in Bulletin No. 243 of this station. This intradermal method has proven very satisfactory in the out-of-door tuberculin testing frequently necessary in this state, and for the non-official testing of large numbers of cattle is preferable to the subcutaneous method. It requires more

experience to apply the test and interpret the intradermal reactions than is required in testing by the subcutaneous or ophthalmic methods.

Some tuberculous cattle react locally to the intradermal test, but fail to react thermally to the subcutaneous test, while others which react thermally fail to react locally. Obviously, then, it is necessary to use both tests in order to detect the maximum number of reacting cattle. The introduction of the intradermal method of tuberculin testing is believed to constitute an important step in the control of tuberculosis in both cattle and hogs under California conditions.

A Study of the Causes and Means of Preventing the Spread of Tuberculosis in Cattle and Hogs in California.—Under this project it is proposed to undertake an extensive study of the conditions under which this disease is spreading. During the past year the work has been directed to trials of methods for detecting open cases of tuberculosis in tuberculous herds. In all 2105 cattle have been given a careful physical examination and the results have been checked by tuberculin tests on every animal, post-mortems in 341 cases and guinea pig inoculation in 41 cases. One of the station veterinarians (Dr. R. M. Bell) has devoted much of his time to the study of the methods for detecting tuberculosis in cattle by physical examination and particularly to trying to pick out by abnormal sounds of the thorax the apparently healthy but tuberculous cattle which have open lung lesions. He has observed that the normal lung tones of cattle having pulmonary lesions are more pronounced during the time that they are reacting thermally to a tuberculin injection. This observation has been put to practical use in co-operative work described under the following project.

Co-operative Experiments in the Control of Tuberculosis.—In co-operation with certain stock owners observations are in progress on seven ranches, including about 2000 dairy cows, 15,000 stock and beef cattle, and 3000 swine. An attempt is being made to apply the known facts concerning the spread of tuberculosis to preventing the spread of the disease on these ranches and the eventual eradication of it. Through these co-operative efforts we hope to work out and demonstrate a system of animal husbandry suited to California conditions which will protect cattle and hogs from tuberculous infection without great expense.

Summary of Tuberculosis Investigational Work.—In addition to the work mentioned above, the veterinarians of this division come in contact with the problems of this disease in dairy certification work, the testing for the Pasadena Board of Health and in the Farmers' Institutes.

The following figures are the combined tuberculin tests by all members of the Veterinary Division for the nine months ending March 31, 1913:

Total number of ranches on which tuberculin tests were made	107
Total number of cattle tested	6004
Total number of cattle that reacted	1831
Percentage of reactors	30

In all, counting retests and tests by various methods applied simultaneously, 9804 tuberculin tests have been made, 6596 of which were by the intradermal, 2745 by the subcutaneous, and 463 by the ophthalmic method. About two-thirds of the tests reported herewith were made for farmers who desired to develop herds of healthy non-reacting animals. Unfortunately the elimination of this disease from a badly infected herd cannot be accomplished simply by testing and removing or segregating the reacting cows. Except in dairies producing certified milk, which brings a high price in the market, it is seldom profitable for a dairyman with a herd containing valuable reacting animals to make the financial sacrifice necessary to completely eradicate the disease. However, the losses from tuberculosis in all classes of cattle and in hogs have reached such proportions that many stock owners are asking for advice. There is great need for further information concerning channels by which this disease is spreading, but if the facts already well known were more generally applied by stock owners there is reason to believe that the losses would be materially reduced Through ignorance or neglect, many dairymen tolerate advanced physical cases of tuberculosis in their herds, and even in the better managed herds it would be possible to improve conditions by pasteurizing the milk fed to calves and by the raising of healthy young stock and keeping them separated from the older infected cattle.

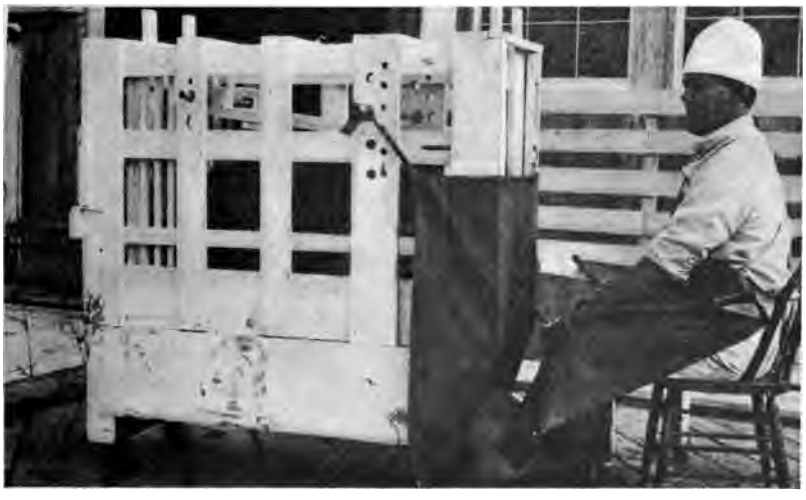
Tuberculin tests and slaughter demonstrations have been conducted at six meetings where large numbers of farmers could see the results, and at every opportunity efforts have been made to disseminate useful knowledge concerning the disease.

The Prevention of Hog Cholera

BY

JAMES F. MITCHELL and WALTER J. TAYLOR

During the year there have been hyperimmunized 350 hogs, 151 of which were bled but once from the throat, 72 once from the tail and once from the throat, 55 four times from the tail, 28 six times, 33 eight times, 9 ten times, and 2 twelve times. We consider that our best results have been obtained by hyperimmunizing a hog for two bleedings, once from the tail and the other from the throat at the time



Drawing anti-hog-cholera serum from the tail of a hog at the University of California Hog Serum Laboratory.

the animal is killed for pork. The two-bleeding method is cleaner than tail bleeding and enables us to post-mortem our hogs before the serum is sold to the farmers. This is important, because in some cases on post-mortem, lesions have been found which have led us to discard serum for fear of internal contamination.

Results of the Use of Anti-Hog Cholera Serum.—During the fiscal year ending June 30, 1914, the hog serum laboratory has produced approximately 1,832,000 cubic centimeters of anti-hog cholera serum, of which we have sold 1,079,655 cubic centimeters. Up to July 1, 1913, every hog owner was allowed 500 cubic centimeters free of charge, but since the state appropriation covering this was exhausted at that

time the distribution of free serum was discontinued. The following table shows the distribution of serum since July 1, 1913:

TABLE I

Total number of applications received	690
Total number of hog owners that applied for serum	407
Total number cc. of serum sold	1,079,655
Total number cc. of virus sold	12,815
Total number hogs treated	38,450
Total number visibly sick hogs treated	2,915
Total number cases using serum and laboratory virus	271
Total number cases using serum and local virus	121
Total number cases using serum alone	298*
Total number cases using double method	15*
Percentage of well hogs that lived	92.2
Percentage of sick hogs that recovered	23.5
Percentage of well hogs lost	7.8

Immunizing against hog cholera under field conditions. Two men can hold any ordinary size hog in above manner without difficulty.

The percentages in this table were computed from signed reports upon the results of treating 4008 hogs. In practically every instance, with the exception of the University Farm, cholera was present on the premises or in the immediate vicinity.

Statistics prepared by the U. S. Department of Agriculture show that when serum is not used from 40 to 80 per cent of hogs in infected

* The ten cases that used the double method are also included in the number using serum and virus.

herds die and many of the balance are left in an unthrifty condition. Our table shows that about 92.2 per cent of the well hogs lived and 23.5 per cent of the sick ones recovered. In considering these figures it must be remembered that many of the so-called well hogs were infected with cholera at the time of injection, but showed no visible symptoms. A low estimate of the saving to the hog owners for the past nine months would be $85,000. This is based upon the value of $10.50 per head given in the official estimates of the U. S. Department of Agriculture.* Adding the above amount to the saving for the previous 21 months, the total amount is estimated at $325,000, which would seem an adequate return for an investment by the State of less than $20,000. While the average loss on the entire herd, sick and well, has been something over 10 per cent, reports from individual herds where serum was used before the herd was infected show an average loss of slightly over 1 per cent, while in many cases there was no loss at all.

Of the 460 applications, 119 came from the Imperial Valley and the results are reported upon below. Of the remainder, 111 were from Los Angeles and surrounding territory, where there are some of the largest hog ranches in the State, most of the hogs being garbage fed. Many of these ranches are under the control of two large companies and practically every hog on them is vaccinated with our serum. It is upon hogs in this district that the value of the serum has been best demonstrated. They have been able to produce a slight degree of immunity in their pigs, which enables the animals to resist infection to some extent. After the pigs have grown to about 20 to 30 pounds, they are all treated with serum and virus. Reports from the largest hog raiser in this district who vaccinates all his pigs in this way are to the effect that his loss has been less than 1 per cent.

Pigs weighing less than fifty pounds may be conveniently held by one man while being immunized against cholera.

On 36 occasions men have been sent from the station to do the work, and the inoculation of pigs has been demonstrated to fifteen persons who have come to the laboratory in order to learn how to administer the serum. In almost every case the results

* See U. S. Department of Agriculture Farmers' Bulletin, No. 575.

following the administration of serum by members of the division have been good. The following tables have been made up from reports covering the work for the nine months, which were received from hog raisers in all parts of the State except Imperial Valley. In these tables a check mark in the sick recovered column indicates that no sick hogs were treated. All sick hogs were visibly sick hogs. If temperatures had been taken, it would undoubtedly be apparent that the number of sick hogs treated was considerably greater than the figures given. The average dosage computed from this table is 28 cc., which is very much below what it should be. Our records show that about 40 per cent of the hog owners returned a portion of the serum which they received from us, although no more than was necessary to treat the number of hogs mentioned in the applications was sent to them. About 7 per cent of the animals reported upon in these tables developed abscesses. In some cases these were undoubtedly due to insanitary methods, but it should be borne in mind that an injection of large quantities of liquid, even if sterile, into the tissues of a hog, under the most sanitary conditions obtainable in field work, will be followed by abscess formation in a certain percentage of cases. Out of 1282 hogs treated with serum and virus in herds where no sick animals were injected, only 23 were lost, which makes an average of about 1.8 per cent loss.

Nineteen cases where unsatisfactory results followed the use of serum are classified as follows:

TABLE II

Scant dosage and scant dosage on badly infected herd	5
Serum where serum and virus should have been used	2
Serum and virus where serum alone should have been used	6
Insanitary methods	2
Unclassified	4

Scant Dosage and Scant Dosage on Badly Infected Herds.—Even in cases where scant dosage was used on herds where 25 per cent of the whole number were already sick, the figures show that 48 per cent were saved. The average dosage in these cases was 16 cc., which is the dose for suckling pigs for serum alone, and in the majority of these cases serum and virus were used on pigs large enough to have had 45 cc.

Serum Alone where Serum and Virus should have been Used.—In the two cases where serum alone was used followed by heavy loss deaths stopped immediately after the use of the serum, but began again about five weeks later. It was very evident that the immunity had run out and the animals had again become susceptible.

Serum and Virus where Serum Alone should have been Used.—In the six cases under this heading, serum and virus were used on herds which were badly infected, and where, therefore, serum alone should have been used.

Insanitary Methods.—In cases where insanitary methods caused loss, abscesses followed the injection of serum, due to one of the following causes or a combination of all of them: either the work was done in dirty, dusty places, the instruments were not properly sterilized, or the animals were turned into dirty pens while the injection wounds were still open. In one case, which was personally investigated, the veterinarian was given very inefficient help and had to work in an extremely filthy chute.

Reports have been received from a number of cases to the effect that when sows have been vaccinated with serum and virus and, in a few cases, with serum alone, their pigs were borne prematurely or died shortly after birth. For this reason it is recommended that pregnant sows should not be vaccinated if it can be avoided, but if it must be done serum alone should be used.

Results of the Use of Anti-Hog Cholera Serum in Imperial Valley

Table III

Number cc. of serum sold July 1, 1913, to March 31, 1914	207,626
Number cc. of virus sold July 1, 1913, to March 31, 1914	4,127
Number of different ranches	96
Number using laboratory virus with serum	65
Number using serum followed by serum and virus	2
Number times man sent to do work	44

A comparison of the results obtained when a representative of the Veterinary Division did the vaccinating and where others have done the work shows that in the latter case not so good results have been the outcome. This should be qualified by saying that some of these vaccinations have been made by a practicing veterinarian in the valley and his results have been practically as satisfactory as those obtained by the division. The reason for poor results where the owners have done the work themselves lies in the fact that they have not taken the precaution of carefully selecting the affected animals with the aid of the clinical thermometer, thereby vaccinating many affected animals which were too badly diseased for the serum to produce the desired effect.

A few cases have occurred in which poor results have been obtained both by the division and by others, due to the fact that cholera-infected hogs have been vaccinated even when the thermometer failed to reveal the fact to the operator. It is possible for a hog to be sufficiently affected with cholera to prevent the serum from protecting the animal against the progress of the disease, and still the animal will show no rise in temperature.

A pen of small pigs ready for immunization with anti-hog-cholera serum. Pigs of this size have been immunized by simultaneous method for about 30 cents per head. Immunity has lasted until hogs were marketed.

Several cases have occurred in which bad results were apparently due to septicemia (blood poisoning) from causes which it has not been able to specify. Several have apparently arisen from serum and virus which contained a large amount of septic organisms. This is borne out by the fact that, while identical methods were used with both serum and virus when the simultaneous method was employed, septicemia has resulted in some cases where the virus was injected in a sufficiently large number of pigs to indicate that the virus was the cause, while in others the same has held true of the serum.

In a few cases it appears that infection has occurred by allowing the animals to have access to dirty wallow holes immediately after vaccination.

In still others poor results have been reported and a careful investigation of the conditions has shown that insufficient sterilization of the apparatus has been the cause.

Tabulation of Results.—It is not possible to make a complete tabulation of the results obtained during the whole of the year, as very many of the ranchers have not sent in reports as they were requested to do. In going over the reports that have been sent in, it is found that they do not exactly correspond with the results noted upon visiting the ranches where the vaccinations have occurred.

Upon Dr. Taylor's arrival in the Valley, September 10, 1913, he began a card index of all the vaccinations carried out by the station. After a sufficient length of time had elapsed, the ranch was again visited and from talks with the owner and personal observation accu-

rate data upon the vaccinations performed since that time were secured.

In many cases vaccination was advised before the disease appeared. This has resulted in a large number of vaccinations, using the simultaneous method, before the disease appeared.

The following tables are compiled from the vaccinations made by veterinarians from the station during the time intervening between September 10, 1913, and March 31, 1914.

TABLE IV.—HEALTHY HERD

Serum Simultaneous Method

Ranch No.	No. died before vaccinated	No. sick when vaccinated	No. vaccinated	No. died after	Per cent loss
1	0	0	13	0	0
2	0	0	45	0	0
3	0	0	38	0	0
4	0	0	10	0	0
5	0	0	21	0	0
6	0	0	6	0	0
7	0	0	78	0	0
8	0	0	75	0	0
9	0	0	40	0	0
10	0	0	35	0	0
11	0	0	7	0	0
12	0	0	16	0	0
13	0	0	20	0	0
14	0	0	25	8	32
15	0	0	53	2	0.37
16	0	0	36	0	0
17	0	0	40	0	0
18	0	0	11	0	0
19	0	0	9	0	0
			578	10	1.7

TABLE V.—DISEASED HERDS

Serum Alone Method

Ranch No.	No. died before vaccinated	No. sick when vaccinated	No. vaccinated	No. died after	Per cent loss
1	1	1	9	0	0
2	15	0	33	0	0
3	6	15	156	54	35
4	8	10	52	8	15
5	4	2	12	4	33
6	4	2	21	10	48
7	1	2	19	2	10
8	10	8	285	5	1.7
9	6	0	75	20	27
10	1	4	96	17	18
11	6	2	45	18	40
12	6	8	70	10	14
13	3	5	45	4	8.8
14	4	5	49	5	10
15	6	10	110	24	22
16	3	9	190	10	5.2
17	0	3	31	2	6.4
18	4	10	49	8	16
19	4	20	253	26	10
20	0	1	49	0	0
21	0	6	7	6	85
Totals,	92	123	1656	233	19

Miscellaneous Investigations Concerning Hog Cholera

BY
FRED M. HAYES

Bacterial Examinations of University of California Serum.—Samples of seven different batches of serum that were ready for use showed an average of 46,486 bacteria per cubic centimeter, and about 90 per cent of these appeared to be a species of streptococci.

Supposed sources of contaminating organisms: (1) Circulating blood of the Hyperimmune. Eleven hyperimmunes which showed indications of abscesses, peritonitis and tuberculosis were bled from the tail without external contamination. The blood from these was sterile.

(2) Contamination of the serum during the removal of the fibrin. The same eleven samples of sera indicated in (1) were plated after defibrination. All showed a few bacteria, varying from 11 to 800 cc. Seven of these samples were defibrinated by hand squeezing of the clot. Four samples were defibrinated by a sterilized meat press. The former method gave the highest count. The latter, while not sterile, showed organisms in too few numbers to be indicated by the dilution made.

(3) The effect of 0.5 per cent carbolic acid upon the organisms in the above sera. Samples of the above sera were kept at icebox temperature for 78 days. Examinations were made eight different

If hogs are run through a trough 12×2½×4 feet deep containing a 2 per cent solution of some good coal tar dip, lice will not bother them. Solution must be kept of constant strength for best results.

times during this period, but the results lacked uniformity, and this question remains unanswered from our work. Several samples, however, showed decided multiplication of the bacteria originally present.

Bacterial Examination of Commercial Sera.—Eleven samples obtained from various commercial firms showed an average number of 2,732,881 bacteria per cubic centimeter. Every sample contained organisms, and these were largely streptococci.

Bacterial Examination of State Sera.—Eleven samples from various state stations showed an average of 3,745,100 bacteria per cubic centimeter. Two samples were sterile so far as could be determined by standard aerobic plating methods.

Potency of State and Commercial Sera.—Seven samples, four commercial and three state sera, showing the highest bacterial count, were used to immunize seven susceptible shotes. The doses were those advised by the manufacturer's label. California virus was injected simultaneously in 1 cc. doses. Two controls died of hog cholera and one sample of commercial serum failed to protect.

Conclusions.—1. Practically all anti-hog cholera sera contain living bacteria.

2. California serum showed the lowest bacterial count.

3. A species of streptococci predominated in all sera examined.

4. Hyperimmunes do not give off bacteria in their blood.

5. Organisms enter the serum during the process of defibrination and bottling.

6. Squeezing the serum from the clot by the hand contaminates the serum to a greater extent than the use of some form of sterilized press.

7. It is possible for organisms to multiply in serum preserved in 0.5 per cent carbolic acid.

8. Very little difference in the number of bacteria in the state and commercial sera examined.

9. State and commercial sera are about equal in potency.

10. A high bacterial count does not necessarily predispose to abscesses.

The Determination and Significance of the Spirochaete Present in the Blood of Hogs Infected with Hog Cholera.—The blood of twelve cholera-infected hogs was examined in dilutions of normal salt solutions, one to five and one to ten, by dark field apparatus. Stained preparations were made with Giemsa's stain, Wright's blood stain, and India ink fixation methods. No spirochaetes were observed.

The blood from two cholera-infected hogs was examined almost daily from time of infection to death. No spirochaetes were observed.

Scrapings from an intestinal ulcer in one hog, however, showed spirochaetes.

The Activities of the Veterinary Division at the University Farm

BY

FRED M. HAYES

Maintenance of a Veterinary Clinic for Student Instruction.—Attempt is made to have all possible cases brought to the Veterinary Hospital for observation and treatment, but the division is called upon to respond to many cases of acute sickness that cannot be brought in. The animals owned by the University at the Farm furnish a large part of the clinic material. The out calls and the daily attention that hospital cases and cases on the University Farm frequently require, consume a large part of the time of the veterinarian in charge. A report of the number of cases treated from October 1, 1913, to April 25, 1914, by the Veterinary Division is tabulated as follows.

Horses	79	Dogs	4
Cows	304	Cats	2
Sheep	3	Chickens	2
Hogs	237	Goats	4

Total, 612

Observations upon the Tuberculin Testing of the Cattle and Hogs at the University Farm.—(*a*) Tuberculin testing of the Dairy and Beef Herd: It has been the practice to make annual tuberculin tests of all cattle at the University Farm. The tests for 1914 were made on April 6th and 7th and April 8th and 9th. Both the subcutaneous and intradermal were used. Three previously tested and non-reacting cows reacted to both of these tests. One cow which has reacted three times during the last two years also reacted to the subcutaneous test. The record of these cows is given in the following table:

	Injection at 9 P.M., 4/6/14 Temperatures before injection			Date 4/7/14 Temperatures after injection							
Test No.	P.M. 1:30	P.M. 4:30	P.M. 8:00	A.M. 5:00	A.M. 7:00	A.M. 9:00	A.M. 11:00	P.M. 1:00	P.M. 3:00	P.M. 5:00	P.M. 6:00
15	2.2	1.4	1.6	1.1	1.2	2.0	2.9	4.5	4.6 4.46	4.2	4.2
19	1.2	1.4	1.3	1.8	1.6	1.9	2.9	3.1	3.2 2.7	2.4	2.2
39	2.0	1.7	1.6	1.6	3.0	3.9	4.3 5.1	5.3	5.4	5.1	.....
113	2.3	4.1	4.0	3.1	4.0	4.8	5.4	5.3	4.9	3.4	.....

Test No.	Intradermal	Intradermal injection at 10 P.M., 4/6/14 Observations 40 to 60 hours after Remarks	Name	Breed
15	+	Size walnut	Minniewawa	Holstein cow
19	+	Size walnut	187	Guernsey
39	+	Size egg	.....	Holstein
113	-	.....	Lustrous	Shorthorn

History of Reacting Animals.—**No. 15:** Purchased and tested subcutaneously in October, 1913. Reaction negative. Came from a herd in which tuberculosis existed.

No. 19: Purchased and tested in October, 1913. Reaction negative. Came from a herd in which tuberculosis existed, but not from same herd as No. 15.

No. 39: Raised on University Farm and passed annual tests of 1912 and 1913. Stanchioned beside cow No. 15 (above). This fact may account for her infection.

No. 113: Shorthorn heifer "Lustrous" reacted to intradermal test in spring of 1912. Reacted typically to subcutaneous October 26, 1913. This cow is very wild and excitable and her normal temperatures vary. It is possible that the intradermal injection was not properly made on the last test, due to the animal not being satisfactorily confined.

It is interesting to note that in the test of March 12 and 13, 1913, a white Shorthorn cow (No. 201) reacted to the subcutaneous test. Her calf was immediately taken from her. She and the Shorthorn heifer Lustrous were isolated and kept together. A cross-bred calf was allowed to suck these two cows from this time until the white Shorthorn (No. 201) was sold in December, 1913. From December, 1913, until February 4, the calf sucked "Lustrous." On February 4, the calf was sold to the butcher. Post mortem examination did not reveal any indications of tuberculosis. Post mortem examination of the white Shorthorn (No. 201) in December, 1913, revealed extensive generalized tuberculosis.

Tuberculin Testing of Hogs at the University Farm.—In December, 1913, a diagnosis of tuberculosis of the udder was made upon "Queen of U. F.," a Duroc sow. This sow and two others which had fall litters were showing enlargements of one or more mammary glands. Tuberculosis was suspected in these also. The intradermal tuberculin test was applied to all the hogs from February 15 to April 1, 1914.

There has been an opportunity to confirm the tuberculin test results on reacting hogs in two instances to date.

Sources of Infection.—With the exception of Stewart's Advancer, Long Advancer, Hillcroft Susan 3rd, and University Lady, all of the hogs reacting were born on the University Farm. These four hogs were bought in July, 1911, and came to the University as gilts. It is not probable that they were responsible for the spread of the infection. The most logical source of the infection seems to have been the skim milk fed mostly during the summer of 1913. This milk was

brought to the creamery from a number of outside farms and no doubt contained tubercular organisms.

It is a fact that with one exception the fourteen large sows that reacted had been fed upon this milk during the summer of 1913; also that the reacting sows were particularly the ones that farrowed in the fall of 1913. On the other hand, the spring pigs (1913) of these same sows failed to react in the test of April 1, 1913, and they too had fed upon the same milk, but in much smaller amounts and for less time.

Immunization of Hogs at the University Farm.—Since May, 1913, the University Farm herd of hogs has been systematically immunized against hog cholera. The frequency of visitors to the hog pen and the showing of some hogs at the fairs render immunization a necessity. A record has been kept of this work, in order that we may have the complete results or effects of immunization in at least one herd. The records are as follows:

May 7, 1913—
Total number of hogs at University Farm 160
Number weighing from 30–60 pounds given serum 112
Number weighing over 300 pounds given serum 40
(Eight shotes to be sold in a few days were not treated.)
May 17, 19, and 20—Serum and virus were administered to the above 152 hogs.

Immediate Effect of Treatment.—There were no indications of cholera, but a few of the large hogs developed abscesses at the point of injection.

Possible Effect of Vaccination upon Breeding.—Of the 112 hogs treated from May 7–20, there remain only twelve sows from which we might draw conclusions as to this point. These hogs were bred in the winter of 1913 to pig in the spring of 1914. The results are indicated as follows:

Name	Breed	No. of pigs farrowed to April 25, 1914
California Pride 2nd	Poland	8 (1st litter).
University Beauty	Berkshire	Did not get with pig.
Sue of U. F. 1st	Tamworth	7 (1st litter).
Sue of U. F. 2nd	Tamworth	11 (1st litter).
*Queen Rival 9th	Berkshire	13 (1st litter).
Matchless Susan 1st	Poland	With pig.
Matchless Susan 2nd	Poland	3 (1st litter).
Matchless Susan 3rd	Poland	With pig.
California Advancer 36	Duroc	14 (1st litter).
Queen of U. F. 2nd	Duroc	6 (1st litter).
Queen of U. F. 3rd	Duroc	With pig.
Advancer of U. F. 4th	Duroc	With pig.

* Reacted to intradermal tuberculin test April 3, 1914.

Of the forty hogs immunized from May 7–20, 1913, the following table will indicate the litters before and after treatment from the hogs on which it has been possible to keep some record:

Name		Breed	Before treatment Spring 1913	After treatment Fall 1913	After treatment Spring 1914	
Long Advancer	+	Duroc	14	16	0 bred	++
Queen of U. F. 1st	+	Duroc	0 bred	7	0 bred	++
Stewart's Advancer		Duroc	10	9	11	++
Princess of U. F.	+	Duroc	8	not bred	10	
Model of U. F.	(1)	Duroc	10	not bred		
Stewart's Sensation	(2)	Duroc				
Miss Advancer of U. F.		Duroc	not bred	not bred	7	++
Missie of U. F.	(3)	Duroc	not bred	0 bred		
Miss Cherry of U. F.	(4)	Duroc	not bred	3		
Happy Girl of U. F.	+	Poland	13	not bred	0 bred	++
Hillcroft Pride	(5)	Poland	12			
Hillcroft Susan 3rd	+	Poland	5	6	10	++
Univ. Farm Sunlight		Poland	10	9	0 bred	++
Univ. Farm Pride	+	Poland	8	not bred	9	
Hillcroft Sunlight		Poland	7	0 bred	0 bred	++
Univ. Farm Pride 3rd	+	Poland	7	not bred	10	++
Early Evening		Poland	7	0 bred	8	++
Grade	(6)	Poland	9	6		
Grade	(7)	Poland	6	0 bred		
Univ. Farm Midnight		Poland	not bred	0 bred	8	++
Matchless Pride 1st	(8)	Poland	not bred	0 bred		
Matchless Pride 2nd	(9)	Poland	not bred	0 bred		
Rockwood Laurel 9th	(10)+	Berkshire	8			
Queen Davis	(11)	Berkshire	10	0 bred		
Grieves Lady Belle		Berkshire	8	not bred	10	++
Duchess 422		Berkshire	9	0 bred	0 bred	
Queen Rival 9th		Berkshire	not bred	5	13	++

+ These hogs were treated with serum alone in October, 1912, after being brought from the State Fair. All developed large abscesses.

++ Hogs that reacted to the intradermal tuberculin in March or April, 1913.

(1) Died in October. Suspected tuberculosis.
(2) Has never been bred. Period of oestrum irregular.
(3) Sold during winter of 1913–14.
(4) Sold during winter of 1913–14.
(5) Sold June, 1913.
(6) Sold during winter of 1913–14.
(7) Sold during winter of 1913–14.
(8) Sold during winter of 1913–14.
(9) Sold during winter of 1913–14.
(10) Died three days after vaccination of May, 1913. Diagnosis not made.
(11) Sold during winter of 1913–14.

Name	Breed	Before treatment Spring 1913	After treatment Fall 1913	After treatment Spring 1914
Queen Davis of U. F. .....(12)	Berkshire	not bred	10	
Univ. Farm Laurel	Berkshire	not bred	not bred	10 ++
Royal Beauty 149 .....(13)	Berkshire	8	0 bred	12 aborted
Lady Premier 140 .....(14)	Berkshire	9	10	11 ++
University Lady	Tamworth	9	10	11 ++
University Co-ed .....(15)	Tamworth	11	0 bred	++

++ Hogs that reacted to the intradermal tuberculin test in March or April, 1913.

(12) Sold during winter of 1913–14.
(13) Hurt in dipping. Paraplegia developed.
(14) Died one month after vaccination in May. Heat prostration.
(15) Sold during the winter of 1913–14.

Comparing the number of offspring from sows that had been bred both before and after the vaccination of May 7 and 17, 1913, we note that from fifteen sows the offspring for the spring, 1913, just before vaccination, was 128 and the offspring from the same sows for the fall of 1913 was 63. This was a decrease of about one-half. The relation may be seen in the following table:

Before treatment of May, 1913.	1	2	3	4	5	6	7	8	
Spring litters of 1913.....	14	0	10	13	5	10	7	7	
After treatment of May, 1913—									
Fall litters of 1913.....	16	7	9	0	6	9	0	0	
Before treatment of May, 1913	9	10	11	12	13	14	15		
Spring litters of 1913.....	9	6	10	9	8	9	11		=138
After treatment of May, 1913—									
Fall liters of 1913.....	6	0	0	0	0	10	0		= 63

For the comparison of the number of offspring from sows that had been bred for pigs before the vaccination of spring, 1913, and the offspring from the same sows in the spring of 1914, there are fifteen, of which we have a record as follows:

Before treatment of May, 1913.	1	2	3	4	5	6	7	8	
Spring litters of 1913.....	14	0	0	8	13	5	10	7	
After treatment of May, 1913—									
Spring litters of 1914.....	0	0	11	10	0	10	0	0	
Before treatment of May, 1913.	9	10	11	12	13	14	15		
Spring litters of 1913.....	8	7	7	8	9	8	9		=123
After treatment of May, 1913—									
Spring litters of 1914.....	9	10	8	10	0	12	11		= 91

NOTE.—Of the six sows that did not farrow this spring (1914) four reacted to the intradermal tuberculin test.

Comparing the total number of pigs farrowed from untreated sows in spring, 1913, and from treated sows in fall, 1913, and spring, 1914, we have the following:

Spring 1913 from 22 sows 187 pigs.	Average per sow 8 plus
Fall 1913 from 21 sows 81 pigs.	Average per sow 4 minus
Spring 1914 from 19 sows 129 pigs.	Average per sow 6 plus

The figures above show a very apparent descrease in offspring from sows that have been vaccinated. *That this decrease is not caused entirely by vaccination but is largely due to a difference in herdsmen that were looking after the feeding and breeding of the hogs, is believed by the writer.* When these large hogs were bred in the spring of 1913 for pigs in the fall (where the decided decrease occurs), many of them had abscesses developed or developing. Some of the abscesses were severe and caused considerable sloughing of tissue in the hams. This may have contributed to the failure to breed or produce normal litters.

In the spring of 1914, there is an increase in pigs from the same sows, but it has not reached the normal. This may be explained by the fact that of the six sows that failed to breed, four of them reacted to the intradermal test for tuberculosis. Furthermore, the Poland boar used for service in the fall of 1913 was purchased late in the fall and some of the sows which did not get in pig at the first or second service were allowed to go over until spring.

Vaccination of Fall Litters, 1913.—In November, 1913, there were fifty-four pigs from fall litters that had not been immunized. These were from immune mothers and weighed from 20 to 50 pounds at the time of treatment. Serum alone was administered November 22, 1913. The serum and virus was given, using 15–20 cc. of serum (Nos. 34 and 38) and 0.5 cc. of virus, on December 2, 1913.

Results and Conclusions from Vaccination of Fall Litters, 1913.—On December 26, 1913, twenty-six pigs had developed abscesses at the point of injection. The serum alone was administered into the right ham; the virus on the second treatment was also given on the right side, and the serum on the left. Most of the abscesses developed on the right side. Abscesses developed in the following pigs:

Duroc-Jersey	(7)	Nos. 63, 61, 62, 57, 59, 55, 52.
Poland-China	(8)	Nos. 65, 60, 55, 56, 50, 52, 51, 54.
Berkshire	(8)	Nos. 57, 60, 59, 51, 50, 53, 56, 55.
Tamworth	(2)	Nos. 52, 53.
Grades	(1)	No numbers.

From the fact that abscesses occurred in both the right and left hams, we are certain that the infection was either carried into the serum injection wound by the needle, entered through the wound after injection, or was in the serum itself. Unfortunately abscesses seem to be an unavoidable acompaniment of the serum treatment. In many instances the abscesses can be properly accounted for by injection of serum with dirty instruments and filthy surroundings in which the operator has to work and in which the hogs live after treatment. In other instances these conditions do not exist and yet abscesses develop. The abscesses above referred to are examples of such results. The conclusion we must reach is that certain bottles of serum have pus-producing organisms in large numbers in them, or that the serum containing the carbolic acid and many corpuscles acts as an irritant to the muscle tissue into which it is injected, destroys some of the tissue and results in an abscess similar to an abscess that might be produced from a bruise, without the breaking of the skin and introduction of organisms from the exterior.

Activities of the Veterinary Division in Southern California

BY
WALTER J. TAYLOR

Upon arrival in the Imperial Valley on September 10, 1913, it became at once apparent that cholera in hogs was the most important subject upon which to fix attention. In comparison with previous years, many were discontinuing the hog industry, due in great part to the prevalence of this disease, which had depleted many herds. Inquiry into the immediate cause of this condition brought the fact that it was the custom among the farmers not to immunize the animals until the disease had begun to appear in the herds. Instruction was given relative to the importance of immunizing before any cholera was present. This has been fruitful of results in a great many cases, as the report submitted under hog cholera will show.

In order to secure the best results in vaccinating hogs against cholera, it was necessary to visit as many places as possible from which requests for anti-hog-cholera serum came. It was found that the cause for many of the apparently poor results in the use of the serum came from the fact that a proper knowledge of the method of application was lacking. When it is clearly understood that the serum is to be used as a preventive and not as a therapeutic agent, sick hogs are not vaccinated, and thus better satisfaction is secured in its application. As a result of this condition, many more applications for advice concerning vaccination as well as requests for the actual performance of the work came in than one man could attend to, and it became necessary to put a second veterinarian in the field. This work has led to a gradual increase in the swine industry of the valley, and many more hogs are being raised than there were six months ago, and some who had discontinued the business are again taking up the industry.

In November, 1913, a request came to the Veterinary Division from a dairyman in Los Angeles County for co-operation in ridding his herd of tuberculosis. On November 2–6 the intradermal test was applied to 819 animals for this man. The reactions obtained showed that 71.4 per cent of the herd were infected with tuberculosis. A system of isolation of affected animals was established, the milk fed to the heifer calf offspring pasteurized, while some of the original cows were sold for beef under proper inspection, and the premises were thoroughly disinfected. At the present time 25 per cent of the original reacting animals have been disposed of, some eighty-five heifer calves

have been produced from the reacting and non-reacting cows, while no more animals other than the progeny of the original stock have been added to the herd. It is the intention to replace the former number of producing animals by careful attention to the offspring. This will take several years to accomplish.

Late in November, 1913, co-operative work with the City of Pasadena was undertaken relative to the tuberculin testing of cattle furnishing milk to that city. The City Council turned over to the University the money available for the work at that time, which was $778 and which appropriation expires July 1, 1914. According to the city ordinance No. 765, only the subcutaneous method of testing is applied. Up to April 1, 1914, 354 animals had been tested. These were located upon forty-eight different farms. The reason for the large number of farms is accounted for by the fact that very many one-cow dairies are in operation in the city. The application of the subcutaneous test under these conditions makes the work more difficult.

Herds in several counties have been examined for the presence of infectious abortion in cattle. In all cases reports from the laboratory at Berkeley have shown the disease to be present. Advice as to isolation, disinfection, and treatment have been given in all cases while further investigations are under way. This disease being one concerning the treatment of which nothing definite is known, the progress is necessarily slow.

Some attention has been given to diseases of live stock in Imperial County under the term of Miscellaneous Investigations Concerning Disease. Thus Dermatitis has been studied to some extent, paralysis in hogs and a condition commonly called "smallpox" in young pigs has been seen. Further studies on these conditions are being carried out.

In Bulletin No. 219 of this station, Dr. C. L. Roadhouse has described, under the name of "Necrotic Dermatitis," a disease of pigs which causes great loss in this valley. On one ranch where there are severe losses among little pigs we are making a careful study of the conditions which may contribute to its existence and spread, and are trying various remedial measures. By animal inoculation and microscopic examination of tissue from the infected pigs, we have proved the presence of *Baccillus necrophorus,* a pathogenic organism which is probably the specific cause of the trouble.

Dairy Certification

BY

CHESTER L. ROADHOUSE

Since July 1, 1913, the College of Agriculture has undertaken the supervision of the production and handling of certified milk for the Alameda County and San Francisco County Medical Milk Commissions.

The Veterinary Division has in charge the inspections, sanitary supervision, bacteriological examinations and tuberculin tests of all dairies certified to by these milk commissions.

The Nutrition Division has charge of the chemical examinations of the certified milk, a report of which will be submitted by Professor Jaffa.

Dairies Supervised and Their Production

Name	Location	No. cows milking		No. quarts per day
Walnut Grove	San Jose	110		1,000
Sleepy Hollow	San Anselmo	180		1,457
H. R. Timm	Dixon	249		2,504
Dixon (Hutton Bros.)	Dixon	171		1,196
University of California	Berkeley	24	milk	215
			skim milk	16
			cream	5 pints
San Ramon	Walnut Creek	90		614
Total certified milk produced				7,002

About 3 per cent of the milk delivered in the bay cities is certified.

The following is the procedure in the supervision of certified milk:

1. Monthly veterinary inspection at each dairy to observe and advise in the health of the herd, health of employees, condition of equipment, methods and sanitation.
2. Monthly dairy inspections by another member of the division to observe methods and sanitation.
3. Semi-monthly bacteriological examinations of samples of milk from each dairy collected from delivery wagons.
4. Semi-monthly chemical examinations of samples of milk from each dairy collected from delivery wagons.
5. Semi-annual tuberculin testing of all animals kept on certified dairy farms.
6. Tuberculin testing of all animals purchased by certified dairies before they are taken to the certified dairy farms.
7. The supervision of the inspector and his reports on the weekly inspections of milk depots and delivery wagons to observe icing and handling of certified milk in Alameda County.

The total number of bacterial examinations of certified milk for the year was 355.

It is worthy of note that of the 305 examinations for the dairies *regularly certified* that only 4.9 per cent were above the requirement.

The average bacterial count for each certified dairy is shown in the following table:

Name of dairy	County sold in	Average bacterial count for the year
Dairy No. 1	Alameda	4,235
Dairy No. 2	San Francisco	8,024
Dairy No. 3	Alameda	9,251
Dairy No. 3	San Francisco	7,697
Dairy No. 4	Alameda	6,134
Dairy No. 4	San Francisco	5,527
Dairy No. 5	Alameda	5,743 (milk) 5,103 (skim milk) 6,608 (cream)
Dairy No. 6	Alameda	4,233
Dairy No. 6	San Francisco	5,268

The following are the results of tuberculin tests of animals for certified dairies:

DAIRY NO. 1

	No. of cows tested	No. condemned	Per cent
Semi-annual test	133	1	.7
Purchased since July 1, 1913	49	0	.0

DAIRY NO. 2

Semi-annual test	259	12	4.6
Purchased since July 1	22	2	9.09

DAIRY NO. 3

Semi-annual test	315	2	.6
Stock raised on place	64	0	.0
Tested and not accepted	9	1	11.1

DAIRY NO. 4

Semi-annual test	119	11	.9
Purchased since July 1	135	6	4.4
Tested and not accepted	9	7	81.0

DAIRY NO. 5

Semi-annual test	35	1	2.8
Purchased since July 1	4	0	.0

DAIRY No. 6

Semi-annual tests	66	2	3.0
Purchased since July 1	176	5	2.8

Total number of animals tested at semi-annual tests	927
Total number of animals condemned at semi-annual tests	29
Per cent condemned at semi-annual tests	3.1
Total number of animals purchased	395
Total condemned from purchased animals	31
Per cent condemned of purchased animals	7.9

In sanitation and in all other respects the certified dairies are well within the regulations prescribed by the milk commissions of the county medical societies, and they are of great value as an example of good dairying to others throughout the state.

The University maintains a certified dairy at Berkeley.

The University of California Certified Dairy.—The policy of the University of California Dairy at Berkeley is to demonstrate the methods for clean milk production to students and others, and in view of this a course of instruction was given in sanitary milk production during the fall semester, in which the students were required to take part in the regular work at the dairy in the feeding and milking of animals, straining, cooling and bottling of milk, the washing and sterilizing of apparatus, cleaning of buildings, etc. The University Dairy being close at hand made it possible for this practice work to be given at Berkeley.

To improve the quality of the product an automatic bottle-capping machine and a complete set of metal-lined delivery cases have been installed. The University Dairy herd now numbers thirty-five head of cows, six two-year-old heifers, one yearling heifer and one calf.

The dairy delivers daily to the faculty and others, on an average of 215 quarts of milk, sixteen quarts of skim milk, and five pints of cream. In additon to this, an average of 675 pounds of butter per month, purchased from the University Farm Creamery at Davis, were distributed in Berkeley at an average selling price of 38¼ cents per pound.

During the year calves were sold at a total price of $113.34. Miscellaneous sales of cow-hides, sacks, etc., amounted to $95.40.

The dairy receipts for the fiscal year 1913–14 follows:

Total milk receipts	$9,839.55
Total butter receipts	3,238.90
Total skim milk receipts	221.45
Total cream receipts	611.10
Number of pounds of butter received from University Farm	8,700
Amount paid for butter received from University Farm	2,678.40

The average butter fat content of certified products was: Milk, 3.9 per cent; skim milk, .3 per cent; cream, 29.2 per cent. The number of bacteria per cubic centimeter was determined semi-monthly, with the following average results:

Milk, 5,743 Skim milk, 5,103 Cream, 6,608

The Medical Milk Commission allows:

Milk, 10,000 Skim milk, 10,000 Cream, 30,000

Dairy Bacteriology

BY
CHESTER L. ROADHOUSE

In addition to routine bacterial counts of milk, certain investigations have been completed. The investigations consisted in the examination of one hundred samples each of milk, skim milk, and cream, the milk originating from different sources. Mr. R. S. Adams, a student in the College of Agriculture, has carried on this work, which is reported upon as follows:

1. Distribution of Bacteria from Clean Fresh Milk (Certified)—
   35 examinations made, showing the average bacterial count for the milk to be 3,683, skim milk 3,449, and cream 3,697.
2. Distribution of Bacteria from Fresh Market Milk—
   30 examinations were made, showing the average bacterial count for the milk to be 50,503, skim milk 35,597, and cream 76,470.
3. Distribution of Bacteria from Aged Market Milk—
   35 examinations were made, showing the average bacterial count for the milk to be 1,770,386, skim milk 1,484,571, and cream 2,212,837.

When milk is separated by means of a centrifugal separator, it is found that different proportions of the bacteria in the original whole milk will be distributed in the resulting skim milk and cream. This proportion varies in different samples of milk having the same bacterial content per cubic centimeter, especially if they were produced and kept under different conditions. This variation may be due to a difference in the specific gravity of the individual organisms found in the milk, or to physical or chemical differences in the milk.

Conclusions.—1. The proportion of bacteria distributed from whole milk into skim milk and cream by means of a centrifugal separator varies in different classes of milk.

2. The skim milk and cream resulting from the separation of fresh certified milk each had a bacterial content about equal to that of the original milk.

3. The skim milk resulting from the separation of fresh market milk contained 29.5 per cent less bacteria per cubic centimeter and the cream 51.4 per cent more bacteria than the milk from which it was separated.

4. When old market milk was separated, the resulting skim milk contained 15 per cent less bacteria and the cream 25 per cent more bacteria than the whole milk.

VITICULTURE AND ENOLOGY

BY

FREDERIC T. BIOLETTI

In addition to the investigational projects of this division included on pages 26–35, the following minor researches have been conducted:

1. Toxic effect of metallic salts on wine yeast (*Saccharomyces Ellipsoideus*).
2. Study of causes of spoiling of canned fruits and vegetables.
3. Sweet wine experiments—
   (*a*) Test of varieties of grapes for sweet wines.
   (*b*) Methods of manufacture to develop processes that will require less alcohol for fortification than is now used.
4. Methods of wine analysis (in conjunction with laboratory of Italian-Swiss Colony).
5. Effects of use of sulfurous acid and pure yeast on stability of wines.

Advanced students have conducted researches as shown below:

1. J. P. Zavalla—Technology of Canning and Causes of Spoilage of Canned Fruits and Vegetables. (M.S. thesis.)
2. L. L. Lieb—Orange By-Products, Methods of Peeling Oranges and Lemons.
3. M. Matsumoto—The "Tourne" Disease of California Wines, and Methods of Control. (B.S. thesis.)
4. J. R. Zion—Pure Yeast and Sulfurous Acid in Fermentation of Apple Juice for Production of Vinegar.
5. E. M. Brown—Sweet Wine Investigations. (B.S. thesis for December, 1914.)
6. H. H. Pandya—Orange Products.
7. A. V. Sifredi—Apple Products: Vinegar, Unfermented Cider.

This division has, in addition to its instruction and research work, engaged in the following activities of public interest:

1. Samples of wine analyzed and advice given for handling same	231
2. Number of people for whom above examinations were made	37
3. Cellars and factories visited at request of owners	8
4. Samples of cider and vinegar examined for vinegar manufacturers	20
5. Number of people for whom above examinations were made	5
6. Cause of spoiling of unfermented cider investigated and remedy suggested.	1
7. Cause of peculiar flavor in 300,000 gallons vinegar located	1
8. Number of vinegar factories in which pure yeast and sulfurous acid were introduced	2
9. Number of people to whom advice was given on orange products	8

10. Number of wineries in which pure yeast and sulfurous acid were demonstrated or introduced 9
11. Number of winemakers, vinegar manufacturers, alcohol manufacturers, public institutions receiving pure cultures of yeast or bacteria 27
12. Miscellaneous products examined: olive oil, jelly, swelled peas, olive pomace, near beer, patent medicine, etc. 20
13. Cuttings of rare or new varieties of vines sent to growers 62
14. Samples of vines, olives, etc., sent by growers examined and reported on. 98

In the following paragraphs is given a summary of the more important or interesting results of the research work of the Division of Viticulture and Enology during the past year.

Effects of Early and Late Pruning of Vines.—Experiments were made in three bearing vineyards: one of Petite Sirah near Woodbridge; one of Zinfandel near Modesto, and one of Muscat at the University farm, with the following results:

Effects on Starting of the Buds.—1. Pruning before the leaves fall in autumn delayed starting of buds slightly.

2. Vines pruned when most dormant started first.

3. Delayed pruning until the terminal buds start delayed the starting of the buds near the base of the canes.

4. Delayed pruning until March 13 saved the crop from a frost occurring on April 21.

5. Whitewashing the vines after pruning delayed the starting slightly.

Effects on Blossoming.—1. Late pruning, after starting of buds, delayed blossoming.

2. When early pruning resulted in frost injury, the late pruned vines blossomed first.

Effects on Crop.—1. Frost injury in spring diminished crop of early pruned vines.

Average crop early pruned vines (Davis) ..... 13.44 lbs.
Average crop late pruned vines (Davis) ..... 18.64 lbs.

2. Pruning after terminal buds had started seemed to increase the crop irrespective of frost injury. (Exp. 5, 6, Davis.)

Average crop of vines pruned March 14 ..... 17.72 lbs.
Average crop of vines pruned April 14 ..... 22.55 lbs.

3. Pruning after the shoots had grown several inches seemed to diminish the crop. (Exp. 6, 7, Davis.)

Average crop of vines pruned April 14 ..... 22.65 lbs.
Average crop of vines pruned May 14 ..... 15.28 lbs.

4. Late pruning delayed the ripening.

Average composition of crop of early pruned vines—
26.6° B; .44 per cent acid.
Average composition of crop of late pruned vines—
23.7° B; .53 per cent acid.
The higher acidity of the grapes of the late pruned vines indicates later ripening and not final lack of sugar.

5. Pruning in May decreased the quality of the grapes.

Composition of grapes from vines pruned in March 14, April 14—
23.7° B; .56 per cent acid.
Composition of grapes from vines pruned in May 14—
23.7° B; .48 per cent acid.
The lower acidity of the grapes from the vines pruned in May indicates lack of proper development.

6. Frost injury in spring did not increase the second crop of Muscat.

Disinfection of Cuttings and Rooted Vines by Immersion in Hot Water.—The disinfection of rooted vines, suspected of being infested with phylloxera, by means of carbon bisulfid is uncertain and liable to injure the plants. Tests were made to determine whether disinfection could not be accomplished with certainty without injury to the vines by immersing in hot water. The temperatures and times fatal to the phylloxera and its eggs and the limits supported by the vines were determined. The following is a summary of the results:

Rooted vines may be safely heated to 60° C for 1 min.
Rooted vines may be safely heated to 55° C for 5 min.
Rooted vines may be safely heated to 50° C for 10 min.
Cuttings may be safely heated to 55° C for 5 min.
Cuttings may be safely heated to 50° C for 10 min.
Phylloxera eggs are killed by 50° C for 1 min.
Phylloxera (root form) killed by 50° C for 3 min.
Phylloxera (root form) killed by 55° C for 1 min.

Conclusion.—Either cuttings or roots may be safely disinfected by immersion in water at 55° C for five minutes.

Relation of the Degree of Ripeness of the Grapes to the Quality and Quantity of the Crop of Raisins.—Much uncertainty exists among raisin growers as to the most profitable stage of ripeness at which to gather Muscat grapes for drying. The problem has three aspects: (1) the effect on the quality of the raisins; (2) the effect on the total quantity of the crop, and (3) the relation to weather and labor conditions. The first two aspects were investigated by gathering five trays of Muscat grapes in the same vineyard at various degrees of ripeness represented by different Balling degrees of the juice from 20° Bal. to 29° Bal.

The following table has been calculated from the results:

Bal. of grapes	Ratio G/R	Increase of crop	Quality	Returns Gross	Returns Net
21	4.15	100	90.0	100.0	100.0
22	3.96	105	.....	105.5	
23	3.76	111	.....	112.2	
24	3.57	117	91.5	119.9	148.6
25	3.37	122	.....	127.8	
26	3.18	128	97.0	138.0	163.8
27	2.98	134	.....	144.0	
28	2.79	139	.....	149.0	
29	2.60	145	96.5	155.5	197.0
30	2.40	.....	.....	.....	
31	2.21	.....	.....	.....	
32	2.01	.....	.....	.....	

G/R = Ratio of weights of fresh grapes and raisins.

This table shows that grapes of 29° Bal. yielded 60 per cent more raisins than grapes of 21° Bal., and that the increase of crop of raisins per acre corresponding to this increase of ripeness was 45 per cent. The quality of the various samples was estimated from the reports of five expert commercial raisin buyers. The gross returns were calculated by multiplying the crop by the quality, and show a gain of 55.5 per cent in favor of the ripest grapes. The net returns or profit exceed this, as the cost of production per pound of raisins decreases with the increase of crop per acre, and may be fairly estimated to be 97 per cent higher for the ripest grapes.

This is strong evidence in favor of the advisability of allowing Muscat grapes to become very thoroughly ripe before gathering for raisins. The gain is so marked that it would well cover much extra expense for occasional "stacking" or even partial loss of the crop in seasons of early rains.

Cap-Stemming Sultannia Raisins.—In the preparation of Sultannia (Thompson Seedless) raisins for the market, the pedicels of the berries must be removed. This is called "cap-stemming," and is accomplished by several mechanical devices. Sometimes, particularly during the summer, the cap-stemming is difficult with certain lots of raisins.

Tests were made to determine whether the temperature of the raisins or their degree of dryness accounted for the observed differences.

Two samples of raisins were obtained from a packing house, one of which "cap-stemmed" perfectly and the other very imperfectly. It was found that by chilling the imperfect sample but little improvement could be effected. By slightly drying, however, it could be

made equal to the good sample. When dried until it lost 4.5 per cent of its weight, the poor sample "cap-stemmed" as readily as the good sample. This per cent corresponds almost exactly with the difference in moisture contents of the two samples.

Poor sample contained	12.140% water
Good sample contained	7.379% water
Difference,	4.761%

The conclusion seems to be, therefore, that in this case failure to "cap-stem" was due to excess of moisture and indicates that during storage the raisins take up water even in the dry atmosphere of the San Joaquin Valley in summer.

Insects Injurious to Stored Raisins.—Much injury is done to raisins by various insects, principally the Raisin Moth (*Plodia interpunctella* Hüb.) and the Saw-toothed Grain Beetle (*Sylvanus suriramensis* Linn.). The methods of control by screening and fumigation have proved ineffective in many cases.

An investigation was undertaken to attempt to find a more certain way of preventing injury from this cause. The local life history of these insects and the local methods of control in the San Joaquin Valley were carefully observed. The conclusions were that slight changes of the methods in use would insure protection.

The fumigating rooms were in some cases not sufficiently air-tight. The rooms should be very carefully constructed to prevent escape of the gas and should preferably be built of concrete, owing to the inflammable nature of the carbon bisulfid gas employed. Ten pounds of this liquid should be placed in several shallow dishes near the top of the room and the fumigation continued for twenty-four hours.

Improvements in the screening and trapping devices should be made. Raisins passed through the sizing and screening machines are freed from most of the insects, but these insects are usually allowed to escape to reinfest new lots of raisins. This applies especially to the beetles. By modifying the shape of the receptacle which receives the screenings, including insects, all the beetles could be caught and destroyed. The modification consists of an over-lapping removable border furnished with a pad saturated with coal-oil or phenol to prevent the escape of the beetles. At intervals this receptacle is emptied and the insects destroyed.

A study of the life-history of the moth indicates that their numbers can be considerably reduced simply by carefully regulating the time of storage of the raisins in the vineyard and packing house. The plan

suggested is: (1) The prevention of the breeding of the insect in the packing house during the winter season, when increase is not liable to occur outside. This is done by bringing the raisins to the house only as fast as needed and of course avoiding the accumulation of anything which might furnish food for the young insects. (2) About the end of April, after a general cleaning-up of the packing house, all remaining raisins in the field are to be brought in to avoid food being there upon which the insect may carry over to the next crop. Thus two or three months of the warmest part of the year without food for the young will cause the race to disappear in the fields and therefore prevent infestation of the new crop in the fall. The seven months in the packing house, during which no raisins will be held long enough to breed out a new generation, should have the same results in that situation.

The adoption of the practice outlined above, taking advantage of the facts in the life histories of these insects, seems a better procedure than to provide abundance of oportunity to increase as is now the rule, requiring expensive treatment with insecticides.

Clarification of Grape Juice.—One of the principal difficulties in the manufacture and preservation of grape juice is to make it perfectly and permanently limpid. Many tests of various methods of defecation, fining, and filtering were made with the following results:

Effect of Defecation.—Defecation gave a clear but not bright liquid before pasteurization, which became cloudy after pasteurization at 185° F. It did not clear perfectly in standing two months after pasteurization, but was in a great deal better condition than the undefecated material.

Juice defecated eleven days before pasteurization became clear before pasteurization, but clouded after heating to 185° F.

Effect of Tannin.—The addition of tannin to defecated and undefecated juice before pasteurization hastened the rate of clearing slightly, but not enough to warrant its use.

Relative Efficiency of Different Fining Materials.—Ten grams isinglass plus 20 grams tannin per hecto, 30 grams isinglass plus 40 grams tannin per hecto, egg albumen 20, 30 and 40 grams per hecto gave rapid clearing of the juice after pasteurization of samples to which the above amounts of fining material were added before heating. Casein gave fair results.

Effect of Filtration before Pasteurization.—Filtration of the defecated and the undefecated juice did not give a clear juice after pasteurization. Filtration with infusorial earth before and after pasteurization did not give a permanently bright juice.

Effect of Fining with Casein at 185° F. followed by Filtration.—Addition of casein finings and heating to 185° F., followed twenty-four hours later by filtration, gave excellent results with Muscat, Furmint, Alicante Bouschet, Alicante Ganzin, and Isabella grape juice.

Separation of Cream of Tartar.—The addition of .2–.4 grams of tartaric acid per 100 cc. gave immediate separation of cream of tartar. Cooling alone did not hasten the separation of the cream of tartar, but cooling after the addition of .1–.4 grams tartaric acid per 100 cc. greatly increased the rate of separation of cream of tartar. Citric acid .1–.2 grams per 100 cc. decreased or prevented the rate of separation of cream of tartar, while the addition of .4 grams citric acid per 100 cc. hastened the rate of separation.

Conclusions.—From the results of these tests it appears that perfect and permanent brightness of grape juice is quickly, surely and easily obtained by the following operations:

1. Defecation for 24–48 hours with 8 to 12 ounces potassium meta-bi-sulfite per ton.
2. Racking of cleared juice; mixing with finings (6 ounces casein or egg albumen per 100 gallons) and heating to 80° C.
3. Addition of .1 per cent to .2 per cent citric acid to the hot juice and allowing to stand at room temperature thirty-six hours.
4. Racking from finings and filtration.
5. Bottling and final pasteurization at 70° to 75° C.

The temperatures mentioned here, while effective for the purpose, are probably unnecessarily high and likely to injure the flavor of the more delicate juices.

Use of Sulfurous Acid and Pure Yeast in Wine-making.—Modern methods of using pure yeasts and sulfurous acid in the fermentation of wine was introduced into many wineries during the last vintage with excellent results. The wines made were examined, analyzed, and compared with wines made by the old methods in the same districts from the same varieties of grapes. The comparison is made in the following tables of wines from a single district.

MICROSCOPICAL EXAMINATION OF WINES

Method of fermentation	No bacteria	A few bacteria	Many bacteria
Ordinary	3	12	34
+ SO_2	10	0	0
+ SO_2 + pure yeast	17	8	0

CHEMICAL EXAMINATION OF WINES

Method of fermentation	No. of wines	Alcohol	Total acid	Vol. acid	Sugar
Red—					
Ordinary	42	12.26	.71	.115	.397
SO_2	1	11.50	.55	.053	.440
SO_2 + pure yeast	24	12.54	.64	.060	.292
White—					
Ordinary	2	11.22	.65	.082	.620
SO_2	6	13.88	.49	.044	.760
SO_2 + pure yeast	3	11.96	.57	.054	.560

The best measure of a clean fermentation—that is a fermentation free from injurious numbers of bacteria—is the lowness of the volatile acid. The superiority of the wines fermented with SO_2 is very marked in this respect. The presence of a large number of injurious bacteria in most of the wines fermented without SO_2 is shown not only by the high volatile acidity, but by direct microscopic examination. The presence of a few bacteria in one-third of the wines fermented with both SO_2 and pure yeast probably indicates simply that owing to the greater clearness of these wines small numbers of bacteria were more easily observed. No wines in practice are completely free from bacteria. The benefits to be obtained from the use of pure yeast are more complete elimination of the sugar, as indicated in the table of analysis and higher quality of flavor and appearance, which were noticeable.

Amounts of Wine and of By-products Yielded by Grapes in a California Winery.—In order to determine the degree of efficiency of our methods of wine-making in utilizing the raw material as accurate an account as practicable was kept of the intake and output of a winery of moderate size. The results are shown in the following tables. These determinations give us some valuable factors for calculating the yields of various products, for planning the character and capacity of various machines, containers, and buildings, and for devising improved methods of more thoroughly utilizing our raw material.

SUGAR CONTENT OF GRAPES CRUSHED (WHOLE VINTAGE)

Pounds of grapes	Max. Bal.	Min. Bal.	Average Bal.
824,157	30.0	17.0	21.875

YIELD OF WINE PER TON OF GRAPES FOR WHOLE VINTAGE

Winery 1—Hydraulic press ..... 177.3 gals.
Winery 2—Continuous press ..... 183.0 gals.

Decrease of Volume in Crushing

	Max.	Min.	Mean
Volume of fresh grapes in cu. ft. per ton	55.66	47.70	52.43
Volume of crushed grapes in cu. ft. per ton	30.10	21.50	26.47
Decrease in volume in crushing	59.5%	41.39%	49.50%

Yield of Stems

	Max.	Min.	Mean
Laboratory tests	7.04%	3.70%	5.49%
Crusher tests	3.23%	.81%	1.24%

Yields per Ton of Wine, Juice, Pomace, Stems, and Lees

	Max.	Min.	Mean
Stems—pounds	64.6	16.2	27.2
Pomace, unfermented—pounds	513.0	265.0	391.0
Pomace, fermented—pounds	392.1	252.0	345.2
Fresh juice—gallons	183.4	160.4	168.7
White wine—gallons	.....	.....	151.0
Red wine, free run—gallons	143.0	127.8	136.4
Red wine, press—gallons	43.1	34.7	38.4
Red wine, total gallons	179.5	170.9	174.9
Lees at first racking (red) per cent of wine	5.19	2.10	3.43
Lees at first racking (white), per cent of wine	4.63	2.22	3.62
Cream of tartar in fresh lees—per cent	15.66	3.08	8.06
Cream of tartar in fresh lees in lbs. per ton of grapes.	.....	.....	4.20

Sugar Balance

	Max.	Min.	Average
Balling degree of grapes	30.00	17.00	21.60
Sugar in grapes—pounds per ton	.....	.....	418.00
Sugar in stems, per ton of grapes	16.61	5.80	9.74
Alcohol in pomace, per cent	8.00	6.75	7.42
Sugar equivalent in pomace, per ton of grapes	.....	.....	52.23
Alcohol in red wine, per cent	10.25	12.90	11.88
Sugar equivalent per ton of grapes	.....	.....	360.06

Sugar in grapes per ton (21.60° B = 20.9% sugar)†		418.00 lbs.
Sugar equivalent of wine per ton of grapes	360.06	
Sugar equivalent of pomace per ton of grapes	52.23	
Sugar equivalent of stems per ton of grapes	9.74*	
		422.03
Sugar utilized in wine	86.1%	
Sugar lost in pomace	12.5%	
Sugar lost in stems	2.3%	
		100.9%

* Weight of sugar in stems is calculated on laboratory tests which are higher than crusher tests. This probably accounts for the fact that the sugar calculated from the alcohol is 4 lbs. per ton greater than when calculated on the Bal. degree of the grapes.

† Calculated from California analyses.

Vinegar-making.—Many complaints have come to the station regarding failures to obtain vinegars of standard strength and quality from apparently good raw material. A considerable amount of work has been done in investigating these troubles, and it appears that imperfect fermentations are the cause of most of them. This is indicated by the following table, which gives the result of fermenting apple juice with sulfurous acid and pure yeast as compared with the spontaneous fermentation usually adopted.

Fermentation I. Spontaneous fermentation in barrel.

Fermentation II. Same apple juice as Fermentation I, but defecated with sulfurous acid and fermented with pure yeast.

After the alcoholic fermentation, the juice was allowed to undergo spontaneous acetic fermentation in the barrel in both cases.

ANALYSES OF NO. I AND NO. II AT VARIOUS TIMES

Sample	Total Acid as Malic	Total Acid as Acetic	Total Sugar	Reducing Sugar	Volatile Acid	Alcohol Vol.
	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
Original must	.66	.....	15	10.4	.....	0
I. Jan. 9, 1913	.....	.84	.55	.....	.....	6.20
II. Jan. 9, 1913	.....	.61	.037	.....	.....	8.00
I. Apr. 5, 1913	.....	1.18	.60	.....	.....	5.6
II. Apr. 5, 1913	.....	5.9	.....	.....	.....	2.56

General results of tests No. I and No. II are decidedly in favor of the use of pure yeast and sulfurous acid. SO_2 and pure yeast gave 1.8 per cent more alcohol than natural fermentation; No. I fermented dry while No. II, natural fermentation, stuck with .6 per cent sugar. The natural fermentation developed tourne bacteria; the other did not.

Germination of Olive Seeds.—According to most European authorities, the best olive trees are those grafted on seedling roots. There is some evidence in California corroborating this view. The germination of olive seeds offers some difficulties due to the large proportion of imperfect seeds in some samples and the slowness of germination in all.

Tests were made to determine a practicable method of eliminating the bad seed and of hastening the germination of the good. The proportion of bad seed varied from 0 to 46 per cent in sixteen samples, tested by cracking and examining the kernel.

RATIO OF GOOD SEED TO BAD

	No. of seed	Good seed Per cent	Bad seed Per cent
1. Seeds from seeding, University Campus	550	60.5	39.5
2. Seeds from Razzo variety, University Campus..	250	54.0	46.0
3. Oblonga, Corning	27	74.0	26.0
4. Medium sized olive, Corning	24	96.0	4.0
5. Smal sized olive, Corning	61	91.8	8.2
6. Redding, Davis	100	99.0	1.0
7. Redding, Fresno	709	85.2	14.8
8. Columella, Niles	100	79.0	21.0
9. Polymorpha, Niles	50	78.0	22.0
10. Regalis, Niles	50	66.0	34.0
11. Pendulina, Niles	50	100.0	0
12. Atro-Rubens, Niles	50	80.0	20.0
13. Rubra, Niles	40	85.0	15.0
14. Picholine d'Aix, Niles	36	86.1	13.9
15. Mission, Davis	38	89.5	10.5
16. Mission, Davis (1914)	100	86.0	14.0

Percentage of Good seed—Maximum 100%, Minimum 54%, Average 81.9%

The bad seeds are of lighter specific gravity than the good, and it was found possible to separate them by floating in a salt solution. Where a solution of suitable concentration was used, an average of 97 per cent of the good seed sank to the bottom. When the seeds which floated in such solutions were removed, of those remaining, 95 per cent were good.

The best concentration of the salt solution depends on the condition of the seeds. Seeds freshly separated from the pulp gave the best separation in a solution containing 25 parts of salt to 100 parts of water by weight. Dried seeds gave the best separation in a 10 per cent solution. In a stronger solution a considerable portion of the good seed floated and was lost. After soaking dried seeds for two days in water, a satisfactory separation was obtained as with fresh seed in a 25 per cent solution. After soaking for fifteen days, the poor seed became almost as heavy as the good and a satisfactory separation by this means was found impossible.

Separation of Good Seed from Bad Seed

(By difference of specific gravity as shown by floating or sinking in various solutions)

A. Fresh Seed—

1. *In water.*

Seedling, U. C. campus: No. of seed 1000, No. floating 7. All seeds that floated were bad. Examination of kernels showed 39.5 per cent of total number of seeds were bad. Water alone is useless for separation.

2. *In 25 per cent brine.*

	No. of seed used	No. that sank		No. that floated		Per cent of good seed retained	Per cent good in seed retained
		Good	Bad	Good	Bad		
Seedling on U. C. campus	100	58	8	....	34	100	87.5
Razzo on U. C. campus	50	27	2	....	21	100	93
Oblonga, Corning	27	20	2	....	5	100	90.9
Medium sized olive, Corning	24	23	1	....	....	100	96
Small sized olive, Corning	61	56	1	....	4	100	92
Redding, Davis	50	49	1	....	....	100	98
Columella, Niles	100	78	2	1	19	98.73	97.5
Polymorpha, Niles	50	39	1	....	10	100	97.5
Regalis, Niles	50	33	2	....	15	100	94
Pedulina, Niles	50	47	....	3	....	94	100
Atro-Rubens, Niles	50	40	3	....	7	100	93
Rubra, Niles	40	33	1	1	5	94	94
Picholine d'Aix, Niles	36	31	....	....	5	100	100

Good kernels in seed before separation 78.33%
Good kernels in seed after separation 96.51%
Good kernels lost in separation ..... .92%

B. Dry Seeds—

1. *Before soaking.*

No. days dried	Variety and locality	Per cent solution	No. seed used	No. that sank		No. that floated		Per cent of good seed retained	Per cent good in seed retained
				Good	Bad	Good	Bad		
2	Seedling, U.C. grounds	25	50	25	1	5	19	83.3	96.1
2	Razzo, U.C. grounds	25	50	14	....	12	24	53.8	100.0
2	Razzo, U.C. grounds	10	50	25	1	4	20	89.65	96.2
12	Razzo, U.C. grounds	10	50	23	2	3	32	88.45	99.0
12	Seedling, U.C. grounds	10	50	30	3	....	17	100.00	90.9

After drying two days, a 25 per cent salt solution not satisfactory because of the loss of good seed. After drying from two to twelve days, a 10 per cent salt solution proved satisfactory.

2. *After soaking.* (Seeds dried 20 days.)

No. days soaked	Variety and locality	Per cent solution	No. seed used	No. that sank		No. that floated		Per cent of good seed retained	Per cent good in seed retained
				Good	Bad	Good	Bad		
2	Seedling, U.C. grounds	15	50	35	12	....	3	100.0	74.5
2	Seedling, U.C. grounds	25	50	29	1	3	18	90.6	96.7
2	Razzo, U.C. grounds....	25	50	25	1	2	22	92.6	96.2
15	Seedling, U.C. grounds	25	50	31	19	....	....	100.0	*62.0
15	Seedling, U.C. grounds	30	50	27	23	....	....	100.0	54.0
15	Seedling, U.C. grounds	35	50	29	21	....	....	100.0	58.0
15	Seedling, U.C. grounds	40	50	32	13	....	5	100.0	71.1
15	Seedling, U.C. grounds	45	50	34	9	....	7	100.0	79.1
15	Redding, Davis	25	50	50	....	....	....	100.0	100.0

* These seeds were not perfectly mature.

After soaking dry seeds two days, a 15 per cent salt solution is not satisfactory, but a 25 per cent salt solution gives satisfactory results. After long continued soaking the poor seed seems as heavy as good seed, and a satisfactory separation cannot be made, even with a saturated salt solution.

If planted without treatment, even good seed is very slow in germinating, most usually requiring a year or more. Various methods of preliminary treatment were tested with the results given in the table on page 198.

Bitter Principles of Olives.—The preparation of olives, either green or ripe, for food consists essentially of the removal of the bitterness. Salt is added partly to improve the flavor and partly as a preservative. When olives are canned or bottled, the latter purpose is unnecessary.

The removal of the bitterness is accomplished by prolonged soaking in water, by treatment with a caustic alkali or, usually, by a combination of both. The exact nature of all the substances to which the bitterness is due does not seem to be well understood, nor the effect on the principles of the various operations of pickling. A series of tests and observations was made to throw light on these points with the following results:

1. *Bitterness and Acidity.*—According to Power and Tutin, the bitter substances are not acids and none of the acids are bitter. Neutralization of the acidity, therefore, does not remove the bitterness.

2. *Solubility of the Bitter Substances.*
   (*a*) Soluble in water.
   (*b*) Soluble in hot alcohol.
   (*c*) Soluble in chloroform.
   (*d*) Slightly soluble in ether.

Light seeds eliminated by separation in 25 per cent salt solution. Heavy seeds planted in 10-inch propagating flats in soil composed of three parts sand one part garden mulch. Flats were filled to within 1 inch of top, seeds were put in, ½ inch more soil added, the whole well firmed. Care was taken to keep ground moist at all times.

List of Tests made	Kinds of Seedlings on U. C. Grounds				Redding, Davis			
	No. of seed used	No. of seed sprouting June 20	No. of seed sprouting Aug. 8	Per cent of seed sprouting	No. of seed used	No. of seed sprouting Jun. 20	No. of seed sprouting Aug. 8	Per cent of seed sprouting
1. Soaked in water 15 days, apex cut	250	98	121	48.4	250	166	221	88.4
2. Soaked in water 15 days, base cut	250	59	110	44.0	250	84	200	80.0
3. Dry seed, apex cut	125	46	55	44.0	.....	.....	.....	.....
4. Dry seed, notch filed near base	50	6	18	36.0	.....	.....	.....	.....
5. Dry seed, base cut	150	39	40	*26.6	.....	.....	.....	.....
6. Dry seed, soaked 1 hr. in 10% solution H_2SO_4	200	23	48	24.0	.....	.....	.....	.....
7. Dry seed, soaked 16 hrs. in 10% potash solution	100	2	21	21.0	.....	.....	.....	.....
8. Dry seed, untreated	250	11	45	18.0	.....	.....	.....	.....
9. Soaked in water 15 days	2075	62	350	17.3	200	17	60	30.0
10. Soaked 30 min. in full strength H_2SO_4	300	13	27	13.5	.....	.....	.....	.....
11. Soaked in lime paste 42 hrs.	50	0	5	10.0	.....	.....	.....	.....
12. Soaked in 10% potash solution 8 hrs.	100	4	†	.....	.....	.....	.....	.....
13. Planted with pulp on	100	0	0	0	.....	.....	.....	.....

* Some lost by damping off. † Whole flat disappeared.

Conclusions—

1. Cutting off apex the most effective aid to germination.
2. Soaking in water for 15 days useless.
3. Soaking in solution of 10 per cent potash or sulfuric acid of litle use.
4. Soaking in strong sulfuric 30 minutes and in lime paste 42 hours apparently injurious.
5. Seeds of naturally poor germinating powers. (Exp. 1–4, Berkeley seedling) gave better results when the apex was cut than seeds of good germinating power (Exp. 9, Redding from Davis) when untreated.
6. When planted with the pulp, the germination is very slow, none starting within five months.

3. *Location of Bitterness in the Olives.*—In crushing olives, much of the bitterness is found dissolved in the juice; much remains in the pulp.

4. *Destruction of Bitterness.*

A. Bitterness is not destroyed by:
- (*a*) Exact neutralization.
- (*b*) Slight excess lye.
- (*c*) Exact neutralization and heating under 15 lbs. pressure 1 hr.
- (*d*) Slight excess HC and heating under pressure.
- (*e*) Heating untreated juice under pressure.
- (*f*) Excess $NaHCO_3$ (sodium bicarbonate).
- (*g*) Yeast fermentation.

B. Bitterness is destroyed by:
- (*a*) Considerable excess NaOH.
- (*b*) Considerable excess Na_2CO_3.
- (c) Slight excess alkali and heating under pressure.

5. *Tests on Juice.*
- (*a*) Addition of 2 per cent KOH destroys bitterness immediately.
- (*b*) Neutralization and addition of .7 per cent excess KOH destroyed bitterness in 24 hrs.
- (*c*) Addition of an excess of .56 per cent had little effect.

These tests indicate that there are several factors at work in the removal of bitterness by the ordinary methods used by picklers.

The bitter principles are freely soluble in water, but it requires prolonged soaking for several weeks or months in frequent changes of water to remove them. The length of time necessary is due to the resistance of the tissues of the olive to the passage of water. This resistance may be diminished by treatment with caustic potash or soda and the time of removal much shortened. Alkalis not only facilitate the extractive action of water, but if used to a certain excess, actually destroy the bitterness by hydrolyzing the bitter principles of which the principle appears to be the glucoside *Oleuropein.*

Softening of Olives.—Certain varieties of olives, and all when overripe, tend to become soft during the pickling processes, especially in the lye solutions. Salt may be used in conjunction with the lye to counteract this softening effect. Tests were made to determine the most favorable amount of salt to use as follows:

1133 ripe Mission olives from Davis.
- (*a*) 1½% KOH (witness).
- (*b*) 1½% KOH + 1% NaCl.
- (*c*) 1½% KOH + 3% NaCl.
- (*d*) 3% KOH + 3% NaCl. Put olives in on Dec. 5, P.M.
- (*e*) 1½% KOH + 5% NaCl.
- (*f*) 1½% KOH + 10% NaCl.

Dec. 6, '13, P.M. (approximately 24 hours later)—
3%, 5%, 10% NaCl made olives firm and leathery; 1% not very effective.

If too little salt is used it has little effect; if too much, it delays the action of the lye. About 3 per cent of salt appears to be suitable and sufficient even with strong lye solutions.

Olive Paste.—Certain varieties of olives are too small to satisfy the popular demand for a large pickle. A certain proportion, sometimes considerable, even of the largest varieties, are too small for the same purpose. These small fruits are used for the manufacture of oil, but their value for this purpose is small. When pickled they are excellent to eat, equallying or exceeding the large olives in flavor.

More or less successful attempts were made to use these small olives and also over-ripe, frost-bitten, and bruised olives for the preparation of an olive paste, which could be used in the same way as the various meat pastes commonly found on the market. It was found possible to remove the pits of the fresh olives, grind up the pulp, remove the bitterness, salt to taste, and thus produce an olive paste that was relished by everyone to whom it was submitted and usually pronounced better than any meat paste and even better than the best ripe pickled olives.

The processes tested were rapid, requiring from forty-eight to less than five hours. It is probable that a process could be devised which would be continuous.

The main defects of this method of utilizing olives are the comparatively small amount of paste yielded by a given weight of olives. The removal of the pits removes from 15 to 30 per cent of the volume of the fruit. The processes used in making the paste cause a further diminution of weight of about one-third. Some of this last loss could very probably be avoided by improved methods of handling.

With the methods used, a ton of small olives would yield on the average about 1000 pounds of olive paste. As the process of manufacture is simple and inexpensive, even this yield should be more profitable than oil-making if the public would be willing to pay as much for olive paste as for meat pastes.

Sizing of Pickled Olives.—Olives to be used for pickling are always passed through a *grader* or *sizer,* which segregates the various sizes. This is necessary, both because olives of different sizes are difficult to pickle properly if mixed and because the larger sizes are much more valuable. The sizing is done with varying degrees of exactness, according to the ideas of the pickler and the type of machine in use.

Determinations of the sizes, i.e., average diameters and corresponding number of olives per pound, was made on a number of commercial samples of pickled olives.

The size is defined by the limits of the short diameter of the fruit in sixteenths of an inch. Four sizes of pickling olives are usually recognized: Size 1, over 16 sixteenths; size 2, from 14 to 15 sixteenths; size 3, from 12 to 13 sixteenths, and size 4, from 10 to 11 sixteenths. Olives under 10 sixteenths of an inch are usually not pickled. The variations in each size differ very much with different brands of olives. The differences depend probably on the kind of sizing machine employed. The following tables gives the results of some measurements made:

AVERAGE DIAMETERS AND NUMBERS PER POUND OF VARIOUS SAMPLES OF PICKLED OLIVES

Sizes	1		2		3		4		5	
Samples	D	N	D	N	D	N	D	N	D	N
1 to 4	16.05	36	13.63	59	11.89	84	11.57	103	9.95	127
5 to 8	.....	....	13.70	62	11.98	88	.....	....	9.98	157
9 to 11	.....	....	13.30	65	12.69	74	11.35	96	.....	.....
12 to 14	.....	....	13.60	62	13.25	68	12.59	76	.....	.....
Means	16.	36	13.56	62	12.45	78	11.83		9.96	142

ESTIMATED AVERAGE NUMBER PER POUND OF VARIOUS SIZES

D = 16	15	14	13	12	11	10
N = 36	45	57	70	85	112	140
Usual grades =	No. 1		No. 2		No. 3	No. 4
N = 36			51		78	126
D = 16			14.5		12.5	10.5

D = average diameter (short) of olives in sixteenths of an inch.

N = number of olives per pound.

DEPARTMENT LIBRARY

BY

MRS D. L. BUNNELL

History.—Since the burning of the old Agricultural Building, seventeen years ago, efforts have been made from time to time to replace the collection of publications issued by the United States and the various state institutions and societies. This collection was first taken care of in the Director's Office. When, however, in 1907, the Director's Office was moved, the room was given over entirely to the collection of agricultural publications and accumulation of agricultural books, and a stenographer placed in charge, who devoted as much time as possible to the library work. In this way, some assistance was secured in holding the collection together, but the work was too spasmodic and unsystematic to make much headway. In our new Agriculture Hall, a larger room was assigned to the Library, and since July 1st an effort has been made by the Librarian (appointed at that time), to make the valuable material available to both instructors and students.

In order to ascertain the extent to which the department library is used by readers, records were kept for three months, with the following result:

	February	March	April
Students and others	1,478	1,466	1,579
Instructors	149	116	129

Accessions.—The number of books added to the library are as follows:

	Volumes
Purchases	525
Gifts	1,007
Total	1,532
Periodicals and serials bound	1,034
Total	2,566

In addition to the above accessioned books many hundred pamphlets have been received through the medium of exchange, and on request, to complete files.

Binding.—The number of books and periodicals bound during the year was 1034. The funds allotted to the library were insufficient to bind five hundred more complete volumes, consisting of annual reports, proceedings of societies, and publications of various state institutions; also many foreign serials. The arrears in binding were the accumulation of many years' standing, caused by lack of money for labor and binding.

Periodicals.—The current periodicals received during the year number:

Domestic	202
Foreign	58
Total	260

Since July 1st, forty-six new titles (domestic) have been added, and thirty-five have discontinued or ceased publication.

The total number of periodicals received is as follows:

By gift and exchange	269
Purchased	21
Total	290

Duplicates.—Duplicates of government, state and society publications were received, sent in some cases to us and in others sent to the library by the staff. These duplicates have been placed in chronological order in the basement, and will be used to assist in completing an extra set of publications which we are getting together for the use of students; also to complete the files of the University Farm and Citrus Experiment Station. The balance, so far as possible, will be used for exchange.

We also receive duplicate copies of the following periodicals, which are sent to the Main Library for file in the Periodical Room:

American Fertilizer.
Better Farming.
Better Fruit.
Breeder and Sportsman.
Breeder's Gazette.
California Cultivator.
California Fruit Grower.
California Garden.
Chicago Dairy Produce.
Farm and Fireside.
Farmers' Review.
Field and Farm.
Hay, Flour and Feed Journal.
Hoard's Dairyman.
Jersey Bulletin and Dairy World.
Kansas Farmer.
Live Stock and Dairy Journal.
Louisiana Planter.
Ohio Farmer.
Orange Judd Farmer.
Oregon Agriculturist.
Pacific Fruit World.

Pacific Poultrycraft.
Petaluma Poultry Journal.
Practical Dairyman.
Progressive Farmer.
Vegetable Grower.
White Breeder's Companion.
Wallace's Farmer.

Other periodicals which are sent to the Periodical Room, Main Library, are:

American Journal of Veterinary Medicine.
Jahresbericht über die leistungen auf den Gebiete des Veterinaire Medizin.
Monatshefte für praktische Tierheilkunde.
Münchener tierärztliche wochenschrift.
Oesterreichische Wochenschrift für Tierheilkunde.
Recueil de Medecine Veterinaire.
Schweizer Archiv. für Tierheilkunde.
The Veterinary News.
Veterinary Record.
Zeitschrift für Fleisch und Milch Hygiene.
Zeitschrift für Infektion Krankheiten der Haustiere.
Zeitschrift für Tiermedizin.
Zeitschrift für Tuberkulose.

Inventory.—An incomplete inventory shows the number of bound volumes to be 5515.

The above does not include the books at the University Farm and Citrus Experiment Station, as records have not yet been completed; nor does it include books on agricultural subjects in the Main Library.

Cataloguing.—Very little has been done in the way of cataloguing, aside from this year's accessions.

We have secured the standard size Dictionary Catalogue of the United States publications, exchanging the smaller 2 × 5 cards, which were used some years ago. We are also beginning to check over the catalogue of station publications to ascertain whether in the past all the cards published have been included.

A list of periodicals received on the basis of exchange:

American Bee Journal ..... Hamilton, Ill.
American Breeder ..... Kansas City, Mo.
American Brewers' Review ..... Chicago, Ill.
American Cultivator ..... Boston, Mass.
American Farming ..... Chicago, Ill.
American Fertilizer ..... Philadelphia, Pa.
American Florist ..... Chicago, Ill.
American Hay, Flour and Feed Journal ..... New York
American Hereford Journal ..... Kansas City, Mo.
American Miller ..... Chicago, Ill.

American Poultry Advocate ..... Syracuse, N. Y.
American Poultry Journal ..... Chicago, Ill.
American Sheep Breeder and Woolgrower ..... Chicago, Ill.
American Wine Press ..... San Francisco, Calif.
Arkansas Farmer and Homestead ..... Little Rock, Ark.
Argonaut ..... San Francisco, Calif.
Australasian ..... Melbourne, Australia
Banker-Farmer ..... Champaign, Ill.
Bendigonian ..... Victoria, B. C.
Berkshire World and Corn Belt Stockman ..... Springfield, Ill.
Better Farming ..... Chicago, Ill.
Better Fruit ..... Hood River, Ore.
Breeder and Sportsman ..... San Francisco, Calif.
Breeder's Gazette ..... Chicago, Ill.
Bonforts' Wine and Spirit Circular ..... New York
Business Farmer ..... Tropico, Calif.
Butchers' and Stockmen's Journal ..... San Francisco, Calif.
California Cultivator ..... San Francisco, Calif.
California Farmer ..... San Jose, Calif.
California Fruit Grower ..... San Francisco, Calif.
California Garden ..... Point Loma, Calif.
California Grange ..... Mountain View, Calif.
California Real Estate ..... Berkeley, Calif.
Campbell's Scientific Farmer ..... Lincoln, Nebraska
Canadian Countryman ..... Toronto, Canada
Canner, The ..... Chicago, Ill.
Carlson's Rural Review ..... Northfork, Neb.
Caterpillar Times ..... Stockton, Calif.
Chicago Dairy Produce ..... Chicago, Ill.
Circle and Success Magazine ..... New York
Coast Seaman's Journal ..... San Francisco, Calif.
Cockerel, The ..... Browns Mills, N. J.
Coleman's Rural World ..... St. Louis, Mo.
Commercial Fertilizer ..... Atlanta, Ga.
Connecticut Farmer ..... New Haven, Conn.
Corn ..... Waterloo, Ia.
Country Gentleman ..... Philadelphia, Pa.
Creamery and Milk Plant Monthly ..... Chicago, Ill.
Creamery Journal ..... Waterloo, Ia.
DuPont Magazine ..... Wilmington, Del.
El Commercio ..... New York
Elgin Dairy Report ..... Elgin, Ill.
Farm Engineering ..... Springfield, Ohio
Farm Journal ..... Philadelphia, Pa.
Farm Life and Agricultural Epitomist ..... Chicago, Ill.
Farm News ..... Springfield, Ohio
Farm Poultry ..... Boston, Mass.
Farm Progress ..... St. Louis, Mo.
Farm Stock and Home ..... Minneapolis, Minn.
Farm and Fireside ..... Springfield, Ohio

Farm and Home ..... Springfield, Mass.
Farm and Orchard ..... Keyser, West Va.
Farm and Ranch ..... Dallas, Tex.
Farmer, The ..... St. Paul, Minn.
Farmer, The ..... Lincoln, Neb.
Farmer and Stockman ..... Des Moines, Ia.
Farmers' Digest ..... Columbia, Pa.
Farmers' Advocate ..... London, Ontario
Farmers' Boy ..... Exeter, Calif.
Farmers' Guide ..... Huntington, Ind.
Farmers' Voice ..... Chicago, Ill.
Farmers' Weekly ..... Bloemfontein, South Africa
Farmers' Wife ..... St. Paul, Minn.
Feathered World ..... Strand, London
Field, The ..... New York
Field and Farm ..... Denver, Colo.
Florida Grower ..... Tampa, Fla.
Florists Review ..... Chicago, Ill.
Flour and Feed ..... Milwaukee, Wis.
Fruit Grower and Farmer ..... St. Joseph, Mo.
Fruitman and Gardener ..... Mount Vernon, Ia.
Fruit and Produce Distributor ..... Portland, Ore.
Furrow, The ..... Moline, Ill.
Garden, The ..... London, Eng.
Garden Magazine ..... New York
Gardeners' Chronicle ..... New York
Gas Power ..... St. Joseph, Mich.
Gentlewoman, The ..... New York
Gleanings in Bee Culture ..... Medina, Ohio
Greens Fruit Grower ..... Rochester, N. Y.
Grizzly Bear ..... Los Angeles, Calif.
Grocer, The ..... San Francisco, Calif.
Good Poultry ..... Saugatuck, Mich.
Harvester World ..... Chicago, Ill.
Hawaiian Forester and Agriculturist ..... Honolulu, T. H.
Hoard's Dairyman ..... Fort Atkinson, Wis.
Holstein Friesian Register ..... Battleboro, Vt.
Home and Farm ..... Louisville, Ky.
Hospodar ..... Omaha, Neb.
Hospodarske Listy ..... Chicago, Ill.
Indiana Farmer ..... Indianapolis, Ind.
Iowa Homestead ..... Des Moines, Ia.
Irrigation Age ..... Chicago, Ill.
Irrigation Record ..... Leeton, N. S. W.
Jersey Bulletin and Dairy World ..... Indianapolis, Ind.
Jewish Farmer ..... New York
Journal of Heredity ..... Washington, D. C.
Kansas Farmer ..... Topeka, Kansas
Kimball's Dairy Farmer ..... Waterloo, Ia.
La Hacienda ..... Buffalo, N. Y.

Lewiston Orchard's Life ..... Lewiston, Idaho
Live Stock and Dairy Journal ..... Sacramento, Calif.
Louisiana Planter ..... New Orleans, La.
Maritime Farmer ..... Sussex, N. B.
Mark Lane Express ..... London, Eng.
Market Growers Journal ..... Louisville, Ky.
Market Letter ..... Portland, Ore.
Michigan Farmer ..... Detroit, Mich.
Milk Trade Journal ..... Waterloo, Iowa
Miller, The ..... London, Eng.
Missouri Farmer ..... Columbia, Mo.
Missouri and Kansas Farmer ..... Kansas City, Mo.
Modern Miller ..... St. Louis, Mo.
Motoring Magazine and Motor Life ..... San Francisco, Calif.
National Farmer ..... Bay City, Mich.
National Farmer ..... Winona, Minn.
National Farmer and Stockgrower ..... St. Louis, Mo.
National Provisioner ..... New York
National Stockman and Farmer ..... Pittsburg, Pa.
National Wool Grower ..... Salt Lake City, Utah
Northwest Farm and Home ..... North Yakima, Wash.
Nebraska Farm Journal ..... Omaha, Neb.
Northwest Horticulturist ..... Tacoma, Wash.
Nut Grower ..... Waycross, Ga.
Ohio Farmer ..... Cleveland, Ohio
Oklahoma Farm Journal ..... Oklahoma City, Okla.
Orange Judd Farmer ..... Chicago, Ill.
Orchard and Farm ..... San Francisco, Calif.
Oregon Agriculturist ..... Portland, Ore.
Out West ..... Los Angeles, Calif.
Overland Monthly ..... San Francisco, Calif.
Pacific Dairyman ..... Seattle, Wash.
Pacific Dairy Review ..... San Francisco, Calif.
Pacific Fruit World ..... Los Angeles, Calif.
Pacific Garden ..... Pasadena, Calif.
Pacific Homestead ..... Salem, Ore.
Pacific Poultrycraft ..... Monrovia, Calif.
Pacific Rural Press ..... San Francisco, Calif.
Pacific Service Magazine ..... San Francisco, Calif.
Pacific Wine, Brewing, and Spirit Review ..... San Francisco, Calif.
Park and Cemetery ..... Chicago, Ill.
Pennsylvania Farmer ..... Philadelphia, Pa.
Petaluma Poultry Journal ..... Petaluma, Calif.
Poultry Husbandry ..... Waterville, N. Y.
Poultry Life ..... Portland, Ore.
Practical Dairyman ..... Syracuse, N. Y.
Practical Farmer ..... Philadelphia, Pa.
Prairie Farmer ..... Chicago, Ill.
Progressive Farmer ..... Dallas, Texas
Progressive Farmer and Southern Farm Gazette ..... Raleigh, N. C.

Pure Products ..... New York
Queenslander, The ..... Brisbane, Australia
Refrigerating World ..... New York City
Reliable Poultry Journal ..... Quincy, Ill.
Roeding's Practical Horticulturist ..... Fresno, Calif.
Rumely Power, Seed and Soil ..... La Porte, Ind.
Rural Californian ..... Los Angeles, Calif.
Rural Home ..... New York
Rural New Yorker ..... New York
Rural Spirit ..... Portland, Ore.
San Francisco News Letter ..... San Francisco, Calif.
San Joaquin Light and Power Magazine ..... Fresno, Cal.
Scientific American ..... New York
Signs of the Times ..... Mountain View, Calif.
Southern Agriculturist ..... Nashville, Tenn.
Southern Fruit Grower ..... Chattanooga, Tenn.
Southern Planter ..... Richmond, Va.
Southwest Trail ..... Chicago, Ill.
Southwestern Stockman and Farmer ..... Phoenix, Ariz.
Standard Oil Bulletin ..... San Francisco, Calif.
Star, The ..... San Francisco, Calif.
State Journal ..... Raleigh, N. C.
Suburban Life ..... New York
Successful Farming ..... Des Moines, Iowa
Successful Poultry Journal ..... Chicago, Ill.
Sugar ..... Chicago, Ill.
Sunset Magazine ..... San Francisco, Calif.
Texas Farm and Fireside ..... Houston, Texas
Texas Stockman and Farmer ..... San Antonio, Texas
Threshermen's Review and Power Farming ..... St. Joseph, Mo.
Town Talk ..... San Francisco, Calif.
Trade, The ..... Baltimore, Md
Utah Farmer ..... Lehi, Utah
Valley Farmer ..... Brownsville, Texas
Vegetable Grower ..... Chicago, Ill.
Wallace's Farmer ..... Des Moines, Iowa
Wasp, The ..... San Francisco, Calif.
Western Canner and Packer ..... San Francisco, Calif.
Western Empire ..... Minneapolis, Minn.
Western Honey Bee ..... Covina, Calif.
Western Journal of Education ..... San Francisco, Calif.
Western Poultry Review ..... Hayward, Calif.
Western Stock Journal ..... Oregon City, Ore.
White Breeders' Companion ..... Rochester, Ind.
Wholesalers' and Retailers' Review ..... San Francisco, Calif.
Wisconsin Agriculturist ..... Racine, Wis.

Newspapers.—One hundred and six newspapers are received in exchange for the publications of this station:

Amador Record, Sutter Creek.
Anaconda Standard, Anaconda, Mont.
Anaheim Gazette, Anaheim.
Benicia Herald, Benicia.
Bien, San Francisco and Oakland.
Bismarck Weekly Tribune, North Dakota.
Blue Lakes Advocate, Blue Lake.
Brawley News, Brawley.
Byron Times, Byron.
California Demokrat, San Francisco.
California Zeitung, San Jose.
Chandler Arizonian, Chandler, Ariz.
Chicago Daily Farmers and Drovers
Chicago Live Stock World.
Cincinnati Weekly Enquirer.
Corning New Era, Corning.
Daily Drovers Journal-Stockman, So. Omaha, Nebraska.
Daily Journal of Commerce, San Francisco.
Daily Outlook, Santa Monica.
Davis Enterprise, Davis.
Denni Hlasatel, Chicago.
Deutsche Zeitung, San Diego.
Dinuba Sentinel, Dinuba.
Dispatch Democrat, Ukiah City.
Evening Tribune, San Diego.
Florida Times Union, The, Jacksonville, Florida.
Fowler Ensign, Fowler.
Fresno Herald, Fresno.
Gateway Gazette, The, Beaumont.
Georgetown Gazette, Georgetown.
Gilroy Advocate, Gilroy.
Glenn Transcript, The, Willows.
Hayward Twice -a-Week Review.
Healdsburg Enterprise, The, Healdsburg.
Healdsburg Tribune, Healdsburg.
Humboldt Times, Eureka.
Independent, The, San Rafael.
Inyo Register, Bishop.
Ione Valley Echo, Ione.
Lake County Bee, Lakeport.
Ledger, The, Reedley.
Lincoln Freie Presse, Lincoln, Neb.
L'Italia, San Francisco.
L'Union Nouvelle, Los Angeles.
Livermore Echo, Livermore.
Madera Mercury, Madera.
Mail of Woodland, The, Woodland.
Mendocino Beacon, Mendocino.
Merced County Sun, Merced.
Merced Express, Merced.
Merced Star, Merced.
Modesto Evening News, Modesto.
Monitor, The, San Francisco.
Mountain Realty, The, Skyland.
Mountain View Register-Leader.
Napa Register, The, Napa.
Napa Weekly Journal, Napa.
Nord-California Herold, Sacramento.
North Fort Worth Sunday News, Fort Worth, Texas.
New Hampshire Farmer, Manchester, N. H.
O'Aranto, Oakland (Portuguese).
Oakland Enquirer, Oakland.
Oakland Journal, Oakland.
Oceanside Blade, The, Oceanside.
Orange Post, The, Orange.
Oshawa Vindicator, Oshawa, Ontario.
Oxnard Courier, Oxnard.
Pasadena Star, The, Pasadena.
Paso Robles Record, The, Paso Robles.
Pleasanton Times, The, Pleasanton.
Point Arena Record, Point Arena.
Porterville Daily Record, Porterville.
Red Bluff Daily News, Red Bluff.
Redlands Review, The, Redlands.
Reno Evening Gazette, Reno, Nev.
River News, The, Rio Vista.
Riverbank Review, Riverbank.
Riverside Daily Press, Riverside.
Saint Helena Star, St. Helena.
Salinas Weekly Index, Salinas.
Salinas Weekly Journal, Salinas.
San Jose Mercury-Herald, San Jose.
San Jose Times-Star, San Jose.
Santa Ana Bulletin, Santa Ana.
Saturday Press, Oakland.
Selma Irrigator, Selma.

Semi-Weekly Farm News, The, Galveston, Texas.
Solano County Courier, Suisun.
Spokesman Review, The, Spokane, Wash.
Sun, The, Colusa, Colusa.
Times, The, State College, Pennsylvania.
Times-Gazette, Redwood City, Redwood City.
Tulare County Times, Visalia, Tulare.
Turlock Journal, Turlock.
Vacaville Reporter, Vacaville.
Ventura Free Press, Ventura.
Ventura Weekly Democrat, The, Ventura.
Watsonville Register, Watsonville.
Weekly Capital City News and Western Farmers Review, Boise City, Idaho.
Weekly Chronicle, The, San Francisco.
Weekly Tulare Register, Tulare.
Yreka Journal, Yreka.

Gifts.—Early in the year, a circular letter was sent to the newspapers of the State, and personal letters written to various agricultural pioneers and others, in the hope of securing old and "out of print" publications (especially Californian) for our library. Letters were also written to various institutions and societies, with the following result:

Donor	Bound volumes	Unbound publications
Adler, D., Windsor, Calif.	....	190
Alabama State Highway Commission, Montgomery, Ala.	....	3
American Automobile Assn., Washington, D. C.	....	2
American National Live Stock Assn., Denver, Colo.	13	....
American Pomological Society, Michigan	....	3
American Portland Cement Manufacturers, Philadelphia, Pa.	....	11
Bade, W. F., Berkeley, Calif.	....	3
Bearss, J. T., Fresno, Calif.	....	750
British Columbia, Deputy Minister of Agriculture	....	53
British Columbia, Department of Agriculture	....	4
Boyd, Jas., Riverside, Calif.	2	1
Burnett, P. H. (Lehigh Valley R. R. Co.), N. Y.	....	5
California Development Board, San Francisco, Calif.	8	....
California State Engineer's Office, Sacramento, Calif.	....	3
Chamber of Commerce, Fresno, Calif.	16	17
Chico Public Library, Chico, Calif.	6	....
Colorado State Board of Horticulture, Denver, Colo.	10	....
Colorado State College of Agriculture, Fort Collins, Colo.	2	3
Colorado State Engineer's Office, Denver, Colo.	2	....
Condit, I. J., University of California	3	....
Conkey, G. E. Co., Cleveland, Ohio	....	2
Cyphers Incubator Co., Oakland, Calif.	....	8
de Rekowski, Chas. W., Detroit, Mich.	....	4
Delaware State Board of Agriculture, Dover, Delaware	24	....
Dore, John S., Fresno, Calif.	77	639
Emerson, H. D., Jackson, Calif.	5	4
Ferguson, A. M., Sherman, Texas	1	....
Florida Commissioner of Agriculture, Tallahassee, Fla.	1	5

Donor	Bound volumes	Unbound publications
Franceschi, C. F., Santa Barbara, Calif.	....	10
Friselle, S. P., Fresno, Calif.	11	14
German Kali Works, San Francisco, Calif.	....	15
Georgia Commissioner of Horticulture, Atlanta, Ga.	....	6
Georgia State Horticultural Society, Athens, Ga.	3	....
Gilmore, J. W., University of California	....	2,250
Harper, T. E., Corning, Calif.	6	28
Housing Commission, Los Angeles, Calif.	....	4
Hilgard, E. W., University of California	9	592
Hunt, T. Forsyth, University of California	10	38
Idaho State Engineer's Office, Boise City, Idaho	....	2
Illinois Farmers' Institute, Springfield, Ill.	13	10
Illinois State Agricultural Society, Urbana, Ill.	12	....
Illinois State Bee-Keepers' Assn., Springfield, Ill.	8	4
Illinois State Board of Horticulture, Normal, Ill.	16	....
Illinois State Food Commissioner, Carbondale, Ill.	10	....
Indiana State Board of Forestry, Indianapolis, Ind.	3	2
Indiana State Library, Indianapolis, Ind.	16	....
John Crerar Library, Chicago, Ill.	....	18
Kentucky Geological Survey, Frankfort, Ky.	....	3
Knowland, J. R., Washington, D. C.	12	....
Kruckeberg, H. W., Los Angeles, Calif.	....	2
Library of Congress, Copyright Deposits	19	38
Library of Congress, Washington, D. C.	90	103
London Board of Agriculture and Fisheries, London	....	135
Locke, Miss, Santa Cruz, Calif.	....	92
Louisiana State Engineer's Office, New Orleans, La.	....	12
Massachusetts State Board of Agriculture, Boston, Mass.	17	13
Maryland Board of Park Commissioners, Baltimore, Md.	1	....
Maryland Commissioner of Health, Baltimore, Md.	....	3
Maryland State Roads Commission, Baltimore, Md.	1	7
Macmillan Company, San Francisco, Calif.	1	....
Main State Highway Commission, Augusta, Me.	6	1
Maine Forest Commissioner, Augusta, Me.	....	3
Maine State Board of Agriculture, Augusta, Me.	37	....
Maine State Library, Augusta, Me.	4	....
Maillard, J., San Francisco, Calif.	33	46
Minnesota State Dairy and Food Commission, Minneapolis, Minn.	6	1
Minnesota State Engineer's Office, Minneapolis, Minn.	6	1
Minnesota Farmers' Institute, Minneapolis, Minn.	5	....
Minnesota Bureau of Commerce and Labor, St. Paul, Minn.	3	3
Minnesota State Agricultural Society, Hamlin, Minn.	2	2
Michigan State Highway Dept., Lansing, Mich.	2	2
Michigan Forestry Commission, Lansing, Mich.	4	4
Meadowbrook Farm, Allendale, N. J.	....	1
Montana State Engineer's Office, Helena, Mont.	....	3
Montana Farmers' Institute, Bozeman, Mont.	5	1
Melon Institute of Industrial Research, Pennsylvania	....	5

Donor	Bound volumes	Unbound publications
Nebraska State Engineer's Office, Carson City, Nev.	....	9
Neff, J. B., Anaheim, Calif.	....	134
Nevada State Engineer's Office, Carson City, Nev.	....	9
New Jersey State Board of Health, Trenton, N. J.	....	1
New Mexico State Engineer's Office, Santa Fe, N. M.	....	6
Norcross, Chas. A., Carson City, Nev.	....	5
North Dakota Farmers' Institute, Fargo, N. D.	....	2
North Dakota State Engineer's Office, Bismarck, N. D.	....	7
Ohio State Highway Commission, Columbus, Ohio	3	....
Oregon State Engineer's Office, Portland, Ore.	....	5
Pacific Gas and Electric Co., San Francisco, Calif.	3	10
Pacific Lumber Co., San Francisco, Calif.	2	....
Perkins, George C., Washington, D. C.	12	....
Pennsylvania Dept. of Agr. (Dairy and Food), Pa.	....	129
Pennsylvania Dept. of Agr. (Zoology), Harrisburg, Pa.	....	15
Pennsylvania Free Library, Philadelphia, Pa.	11	....
Philippine Islands, Bureau of Science	....	10
Plymouth Rock Squab Co., Boston, Mass.	1	....
Popenoe, F. W., Altadena, Calif.	1	5
Prange, H. M. G., Jacksonville, Fla.	....	2
Rhode Island Park Museum, Providence, R. I.	....	12
Rixford, E. H., San Francisco, Cal.	1	....
Roeding, Geo. C., Fresno, Calif.	1	2
Robertson, Geo. (State Statistician), Sacramento, Calif.	4	....
Rowell, Chester A., Fresno, Calif.	71	182
Sanford, J. A., Stockton, Calif.	....	8
Saylor, W. H., San Francisco, Calif.	....	1,011
Scotland, Division of Agriculture, Edinburgh	....	13
Sellers, C. H., Sacramento, Calif.	1	....
South Africa, Division of Entomology, Pretoria, S. A.	....	14
South Dakota State Engineer's Office, S. D.	....	2
Sunset Magazine, San Francisco, Calif.	....	140
Teague, R. W., San Dimas, Calif.	....	1
Tennessee State Geological Survey, Nashville, Tenn.	3	12
Utah State Engineer's Office, Salt Lake City, Utah	....	6
U. S. Dept. of Agriculture Library, Washington, D. C.	56	686
U. S. Brewers' Assn., New York	4	....
Volck, W. H., Santa Cruz, Calif.	....	32
Western Pacific Railway Co., San Francisco, Calif.	2	10
Wickson, E. J., University of California	310	8,552
Wight, J. B., Cairo, Ga.	....	6
Woll, F. W., Davis, Calif.	1	....
Woodworth, C. W., University of California	18	....
Wyoming State Engineer's Office	....	11
Total	1,046	16,233

APPENDIX

SMITH-LEVER ACT

[PUBLIC—No. 95—63RD CONGRESS]

[H. R. 7951]

An Act to provide for co-operative agricultural extension work between the agricultural colleges in the several States receiving the benefits of an Act of Congress approved July second, eighteen hundred and sixty-two, and of Acts supplementary thereto, and the United States Department of Agriculture.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That in order to aid in diffusing among the people of the United States useful and practical information on subjects relating to agriculture and home economics, and to encourage the application of the same, there may be inaugurated in connection with the college or colleges in each State now receiving, or which may hereafter receive, the benefits of the Act of Congress approved July second, eighteen hundred and sixty-two, entitled "An Act donating public lands to the several States and Territories which may provide colleges for the benefit of agriculture and the mechanic arts" (Twelfth Statutes at Large, page five hundred and three), and of the Act of Congress approved August thirtieth, eighteen hundred and ninety (Twenty-sixth Statute at Large, page four hundred and seventeen and chapter eight hundred and forty-one), agricultural extension work which shall be carried on in co-operation with the United States Department of Agriculture: *Provided,* That in any State in which two or more such colleges have been or hereafter may be established the appropriations hereinafter made to such State shall be administered by such college or colleges as the legislature of such State may direct: *Provided further,* That, pending the inauguration and development of the co-operative extension work herein authorized, nothing in this Act shall be construed to discontinue either the farm management work or the farmers' co-operative demonstration work as now conducted by the Bureau of Plant Industry of the Department of Agriculture.

SEC. 2. That co-operative agricultural extension work shall consist of the giving of instruction and practical demonstrations in agriculture and home economics to persons not attending or resident in said colleges in the several communities, and imparting to such persons information on said subjects through field demonstrations, publications, and otherwise; and this work shall be carried on in such manner as may be mutually agreed upon by the Secretary of Agriculture and the State agricultural college or colleges receiving the benefits of this Act.

SEC. 3. That for the purpose of paying the expenses of said co-operative agricultural extension work and the necessary printing and

distributing of information in connection with the same, there is permanently appropriated, out of any money in the Treasury not otherwise appropriated, the sum of $480,000 for each year, $10,000 of which shall be paid annually, in the manner hereinafter provided, to each State which shall by action of its legislature assent to the provisions of this Act: *Provided,* That payment of such installments of the appropriation hereinbefore made as shall become due to any State before the adjournment of the regular session of the legislature meeting next after the passage of this Act may, in the absence of prior legislative assent, be made upon the assent of the governor thereof, duly certified to the Secretary of the Treasury: *Provided further,* That there is also appropriated an additional sum of $600,000 for the fiscal year following that in which the foregoing appropriation first becomes available, and for each year thereafter for seven years a sum exceeding by $500,000 the sum appropriated for each preceding year, and for each year thereafter there is permanently appropriated for each year the sum of $4,100,000 in addition to the sum of $480,000 hereinbefore provided: *Provided further,* That before the funds herein appropriated shall become available to any college for any fiscal year plans for the work to be carried on under this Act shall be submitted by the proper officials of each college and approved by the Secretary of Agriculture. Such additional sums shall be used only for the purposes hereinbefore stated, and shall be allotted annually to each State by the Secretary of Agriculture and paid in the manner hereinbefore provided, in the proportion which the rural population of each State bears to the total rural population of all the States as determined by the next preceding Federal census: *Provided further,* That no payment out of the additional appropriations herein provided shall be made in any year to any State until an equal sum has been appropriated for that year by the legislature of such State, or provided by State, county, college, local authority, or individual contributions from within the State, for the maintenance of the co-operative agricultural extension work provided for in this Act.

SEC. 4. That the sums hereby appropriated for extension work shall be paid in equal semi-annual payments on the first day of January and July of each year by the Secretary of the Treasury upon the warrant of the Secretary of Agriculture, out of the Treasury of the United States, to the treasurer or other officer of the State duly authorized by the laws of the State to receive the same; and such officer shall be required to report to the Secretary of Agriculture, on or before the first day of September of each year, a detailed statement of the amount so received during the previous fiscal year, and of its disbursement, on forms prescribed by the Secretary of Agriculture.

SEC. 5. That if any portion of the moneys received by the designated officer of any State for the support and maintenance of co-operative agricultural extension work, as provided in this Act, shall by any action or contingency be diminished or lost, or be misapplied, it shall be replaced by said State to which it belongs, and until so replaced no subsequent appropriation shall be apportioned or paid to said State,

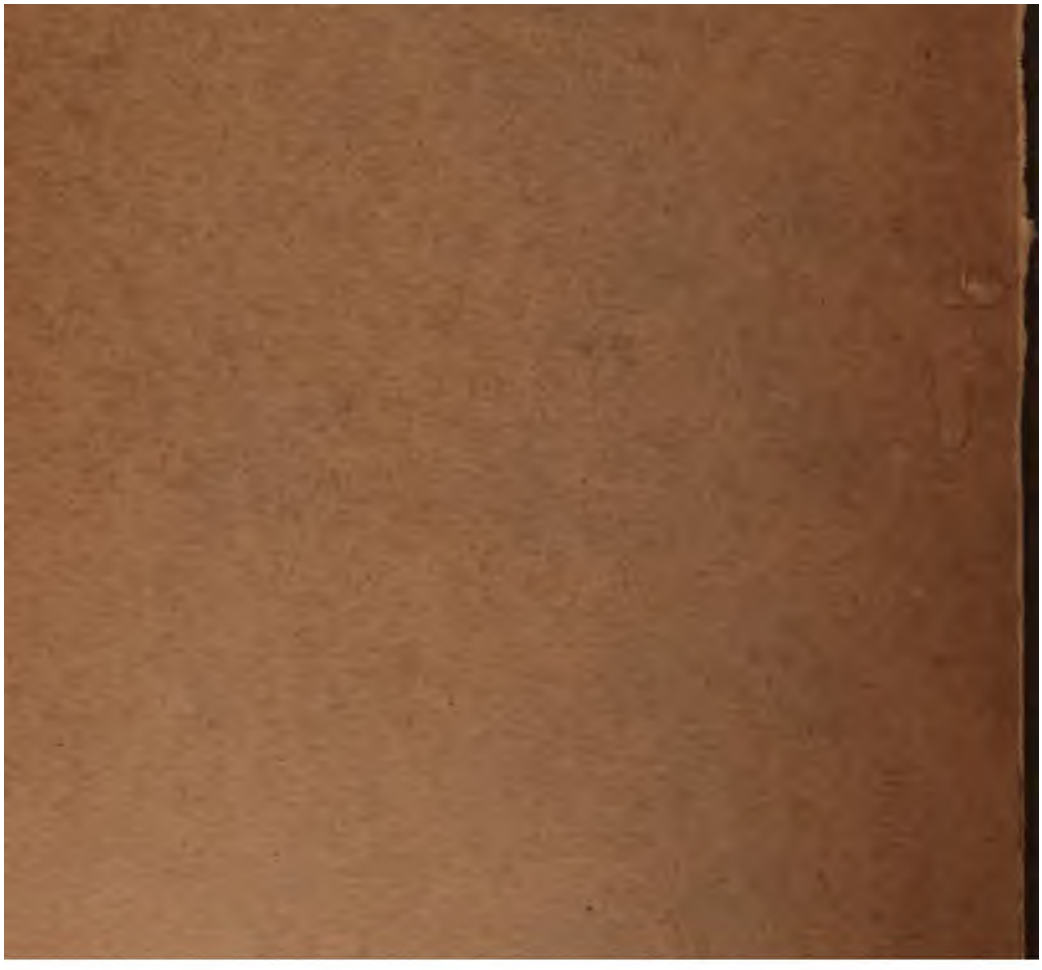
and no portion of said moneys shall be applied, directly or indirectly, to the purchase, election, preservation, or repair of any building or buildings, or the purchase or rental of land, or in college-course teaching, lectures in colleges, promoting agricultural trains, or any other purpose not specified in this Act, and not more than five per centum of each annual appropriation shall be applied to the printing and distribution of publications. It shall be the duty of each of said colleges annually, on or before the first day of January, to make to the governor of the State in which it is located a full and detailed report of its operations in the direction of extension work as defined in this Act, including a detailed statement of receipts and expenditures from all sources for this purpose, a copy of which report shall be sent to the Secretary of Agriculture and to the Secretary of the Treasury of the United States.

SEC. 6. That on or before the first day of July in each year after the passage of this Act the Secretary of Agriculture shall ascertain and certify to the Secretary of the Treasury as to each State whether it is entitled to receive its share of the annual appropriation for co-operative agricultural extension work under this Act, and the amount which it is entitled to receive. If the Secretary of Agriculture shall withhold a certificate from any State of its appropriation, the facts and reasons therefor shall be reported to the President, and the amount involved shall be kept separate in the Treasury until the expiration of the Congress next succeeding a session of the legislature of any State from which a certificate has been withheld, in order that the State may, if it should so desire, appeal to Congress from the determination of the Secretary of Agriculture. If the next Congress shall not direct such sum to be paid, it shall be covered into the Treasury.

SEC. 7. That the Secretary of Agriculture shall make an annual report to Congress of the receipts, expenditures, and results of the co-operative agricultural extension work in all of the States receiving the benefits of this Act, and also whether the appropriation of any State has been withheld; and if so, the reasons therefor.

SEC. 8. That Congress may at any time alter, amend, or repeal any or all of the provisions of this Act.

Approved, May 8, 1914.

AGRICULTURE HALL

The headquarters of the College of Agriculture and the Agricultural Experiment Station of the University of California is on the University campus, Berkeley. There are important activities at the University Farm, Davis, the Citrus Experiment Station, Riverside, the Southern Pathological Laboratory, Whittier, the Kearney Park Experiment station, Fresno, and the Imperial Valley Farm, El Centro.